

# THE MASKELL SPECIES OF SCALE INSECTS OF THE SUBFAMILY ASTEROLECANIINAE

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## INTRODUCTION

This paper presents the third completed set of results derived from the study of the collection of scale insects accumulated by Mr. W. M. Maskell of New Zealand during the years 1869 to 1897.<sup>1</sup>

The species considered here are those from the Maskell collection which are definitely assignable to some one of the genera now included in that section of the old subfamily Dactylopiinae which is currently designated as the subfamily Asterolecaniinae. As in previous work on this collection, a certain amount of confusion and misidentification has been discovered, and it has in consequence been necessary to discuss some species in addition to those actually described by Maskell, and to erect certain new species based on specimens confused with Maskell's species.

Only three of the species currently assigned to the group have been considered previously in connection with the study of the genotypes represented in the collection. One of these is *Frenchia casuarinae* Maskell, another is *Callococcus pulchellus* (Maskell), and the third is *Solenococcus fagi* (Maskell). Additional species in all of these genera are discussed in this paper.

In the absence of an even approximately adequate basic classification of the genera comprising the group, no attempt has been made in the following treatment of genera and species to arrange either in any systematic scheme, a simple alphabetical sequence being employed instead.

As with many other Maskell species, those considered here are often represented by poor or inadequate specimens, and it has consequently been impossible to discuss fully the details of the structure of some of them.

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<sup>1</sup> An explanation of the developments which permitted the initiation of this work was given in Proceedings of the United States National Museum, vol. 60, art. 12, Ser. No. 2407, 1922, pp. 1 to 3, which was published on May 12, 1922. The second paper appeared as art. 17, Ser. No. 2463 in vol. 62 of the Proceedings of the United States National Museum, which was published on June 9, 1923.

## Genus AMORPHOCOCCUS Green

In 1919, Prof. G. F. Ferris transferred to this genus a species which he believed represented Maskell's *Sphaerococcus leptospermi*. As has been pointed out in discussing the true *leptospermi* in this paper, Ferris's conclusions were based on a misidentification, and in consequence the insect discussed by him remains without a name. The available material representing it is very unsatisfactory, largely through injury by parasites, and the description given below is not entirely adequate. Following Professor Ferris, the species is left tentatively in the genus *Amorphococcus*, although there is a serious question as to the correctness of such placing, and it seems probable that the species will be found to be much more nearly related to the genus *Lecaniodiaspis*.

## AMORPHOCOCCUS LEPTOSPERMI, new species

Plate 1, figs. 1-10

*References.*—Froggatt, N. S. Wales Dept. Agr., Sci. Bull. 19, 1921, p. 11 (as *Sphaerococcus leptospermi* Maskell).—Ferris, Can. Ent., vol. 50, 1919, p. 250 (as *Amorphococcus leptospermi* (Maskell)).

*Adult female.*—Forming a swollen twig gall as described and figured by Froggatt; exact shape and size of body uncertain, probably about 2.5 mm. long to 3 mm. long and stout elliptical; derm membranous to somewhat chitinized; antennae reduced to short 2-segmented stubs (Ferris says 3 to 4 segments), bearing several stout setae at tip of apical one; legs wanting; beak stout conical, 1-segmented; spiracles small, with bar enlarged at inner end, with a cluster of quinquelocular disk pores at opening, this continued as a loose band to another cluster at body margin, this last normally accompanied by two stout spiracular spines in the case of the anterior spiracles, one of these large, about  $28\mu$  long, one small, about  $10\mu$  long, these wanting with the posterior pair of spiracles; pores of posterior spiracular band not cleft to form two diverging arms; body, so far as can be determined, without definitely differentiated marginal setae; with some small setae dorsally and ventrally, no certain details of number, size, and arrangement determinable from the material examined; with some larger setae at posterior apex of body, including one pair of definitely differentiated apical ones; dorsum with small, but not minute, 8-shaped pores, with elongate tubular ducts and with minute circular simple pores scattered, apparently rather uniformly, but nowhere thickly, over the dorsal surface; with multilocular disk pores, normally with 10 loculi, in an uncertain number of transverse bands or rows in the posterior ventral abdominal area; with two longitudinal rows of tiny, irregularly rounded, cribriform plates, including from six to seven in each row;

anal region much as in *Lecaniodiaspis*, invaginated, with two pseudo-plates, each somewhat wrinkled and bearing two small setae, about  $8\mu$  long, towards the posterior end; anal ring narrow, with a single row of pores and six setae, each about  $58\mu$  long; apical setae about  $60\mu$  long.

*Larva* (very poor embryonic only).—Shape uncertain; antennae 6-segmented, third and sixth nearly equal; legs not unusual; anterior spiracles with a single short broad spiracular spine at margin opposite each, this accompanied by a much smaller rounded spine; anal region much as in *Lecaniodiaspis* larvae, ring with six setae.

*Holotype and paratypes*.—Cat. No. 40358, U.S.N.M.

Described from a few imperfect examples received within their galls from Mr. W. W. Froggatt under his lot No. 24, collected by him on *Leptospermum laevigatum* (Myrtaceae) in New South Wales.

As indicated above, the actual affinities of this species seem to be with the genus *Lecaniodiaspis*, rather than with *Amorphococcus*, the only important morphological differences, so far as the species of the first genus have been studied, lying in the greater reduction of the antennae and in the smaller number of anal ring setae. The habit is, of course, quite different from that normal to *Lecaniodiaspis*. Pending critical study on the Asterolecanine genera, it has seemed best to refrain from an attempt to place this insect generically with any positiveness. From the available information, it appears to differ decidedly from the other two species, *mesuae* Green and *acaciae* Brain, now included in *Amorphococcus*.

#### Genus ASTEROLECANIUM Targioni-Tozzetti

So few species in this genus were described by Maskell that no attempt has been made in this paper to do more than indicate the closest relatives of the species considered. From the complications that have developed from this limited study of the specimens included in the Maskell collection and of specimens supposed to represent certain of his species, received from other sources, it seems highly desirable that all obtainable material of at least the Australian species of the genus should be worked over critically.

#### ASTEROLECANIUM ACACIAE, new species

Plate 1, figs. 11-20

*References*.—Maskell, Trans. N. Z. Inst., vol. 27, for 1894, 1895, p. 63 (part).—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 759 (part).

*Habit*.—On twigs of the host; the test with a whitish fringe.

*Adult female*.—As mounted, practically circular, diameter 0.7 mm.; derm membranous; antennae reduced to small cones bearing two or three stout setae; legs wanting; spiracles small, each with a loose

band of multilocular disk pores running to margin; beak very short conical, 1-segmented; with a few short, stiff setae in the genital region, no others observed; 8-shaped pores in a fairly definite double row around body margin, except for a short distance at the posterior end; no large 8-shaped pores present dorsally, but with many very small ones distributed fairly uniformly; tubular ducts rather numerous, long but not conspicuous; apparently without quinquelocular disk pores, replaced at spiracles and along margin by small size multilocular disk pores, mostly with 10 loculi, but somewhat variable, a single row of these pores accompanying the marginal row of 8-shaped pores; with distinctly larger multilocular disk pores apparently in two transverse rows in the genital region; no minute simple pores observed; anal region not at all developed, the lobes not definitely formed, location indicated by a group of small setae, one larger, three somewhat smaller, one still smaller; anal ring represented by a small, cylindrical, somewhat chitinized tube, no definite ring, no ring setae, no chitinization of any sort.

No other stages available for description.

Described from two mounted specimens obtained from the Maskell collection, and, on the basis of his descriptive notes, collected at Sydney, New South Wales, on *Acacia* species. This material was a part of his lot No. 423, and was regarded by him as the species *ventruosum*.

*Holotype and paratype*.—Cat. No. 40359, U.S.N.M.

The actual relationships between this species and the other members of the genus *Asterolecanium* are not altogether certain. From their descriptions, it seems most closely related to *ceriferum* Green, *pubibundum* Green, and *spectabile* Newst.

#### ASTEROLECANIUM EPACRIDIS (Maskell)

Plate 2, fig. 1; Plate 27, fig. 1

*Reference*.—Fernald, Cat. Cocc. World. 1903, p. 50.

The Maskell collection contains three slides of this species, one of "Female, 2nd stage, from *Leucopogon*, Aug., 1881," the other of "Insects, 2nd and 3rd stages on leaves of *Leucopogon*, Sept., 1881," and one of "Young insect, from *Leptospermum*, Mar., 1884." Only a single unmounted specimen listed under No. 66 remains in the collection. The third or larval slide has been eliminated from consideration, as the correctness of its identification is open to question. The second slide is not a true microscopic mount and in consequence is of no value in a study of the structure of the species. There has been left for study only the first slide listed, and the condition of this is such that nothing more than a few notes on the structure could be obtained. It is not possible to state definitely

that this specimen is an adult female, although it is our impression, after examining it, that this is the case. The descriptive notes follow:

*Female* (second stage or adult).—External covering and appearance not noted (see Maskell's papers for notes on these); oval, very slightly narrowed behind; antennae of the usual minute size characteristic of the genus, legs wanting; 8-shaped pores present in a single continuous marginal row, this supplemented by similar pores distributed at intervals along and close to the marginal row and, in addition, by a loose cluster of three to six such pores above the spiracles on each side; marginal row of 8-shaped pores accompanied by a continuous row of small circular pores, these about half as numerous as the 8-shaped pores, the arrangement, in general, being an 8-shaped pore with a circular pore, then an 8-shaped pore without the circular pore, then another accompanied by a circular pore, and so on in alternation; presence or absence of abdominal multilocular disk pores not determined; anal lobes scarcely indicated; anal lobe seta between two and three times as long as the average anal ring seta; anal ring well developed, with six setae.

If it be assumed that Maskell's "2nd stage female" is actually an adult, as is believed, then this species may be fairly definitely placed in the genus as being related to *aureum* and *bambusae*, since the occasional submarginal 8-shaped pores are present, supplementing the marginal row, as in *aureum*, while there are only a few additional 8-shaped pores in the mid-dorsal region as in *bambusae*.

#### ASTEROLECANIUM STYPHELIAE (Maskell)

Plate 2, figs. 2-14; Plate 27, fig. 2

*References*.—Fernald, Cat. Cocc. World, 1903, p. 54.—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 759.—Green, Bull. Ent. Res., vol. 6, 1915, p. 48.

The Maskell collection contains eight slides of this species, one of "adult females and males in situ (Australia), 1891," one of "adult female (Australia), 1891," one of "adult female, 1892," one of "adult female, 1894," one of "2nd stage females, 1892," one of "males, 1891," one of "male pupa in test, 1893," and one of "larvae (Australia), 1891." None of these is really good. The unmounted material, placed under lot No. 218, evidently includes more than one lot of specimens, one of which represents a closely related but apparently distinct species. Additional examples, received from French and Froggatt, have been available for comparison.

*Adult female*.—See Maskell and Froggatt descriptions for characterization of test and other external details; fully distended body, as mounted, distinctly longer than broad, an average specimen 0.93 mm. long and 0.66 mm. wide, posterior end somewhat narrowed;

derm membranous; antennae reduced to small slightly protruding knobs, bearing three to five fairly evident setae at apex; legs wanting; spiracles with a slightly curved bar and a few, usually from four to eight, small quinquelocular disk pores between opening and margin; beak very short conical, 1-segmented; with an occasional tiny submarginal ventral seta, and a few small setae ventrally at the posterior end of the body in the genital region; no spiracular spines; 8-shaped pores of normal size in a single marginal row extending completely and continuously around the body excepting only for a small space adjacent to the anal lobes; with a fairly distinct ventral submarginal row of minute 8-shaped pores paralleling the marginal row, although distinctly separated, and with a few similar, but even smaller, pores scattered dorsally; tubular ducts evident, rather uniformly distributed, not very numerous nor crowded; with a row of quinquelocular disk pores, slightly more numerous than the 8-shaped pores, placed immediately below and accompanying the marginal row of 8-shaped pores for practically its whole length; with five definite midventral abdominal segmental rows of multilocular disk pores, each pore with around 10 loculi, and with a few pores on each side near the margin on the two or three segments anterior to these; tiny simple pores present dorsally, but very rare, one occurring at wide intervals in the submarginal region and a few over the dorsal area; anal lobes slightly protruding, each bearing a rather stout apical seta about  $70\mu$  long, and one or two much smaller setae below and one within, these about  $7\mu$  long; anal ring only very slightly invaginated, the inner faces of the lobes and a somewhat protruding collar above and below the ring chitinized; ventral face of each lobe with a definite elongate chitinized thickening of somewhat variable dimensions; anal ring well developed, with pores and six setae, each about  $25\mu$  long.

*Preadult female*.—Closely resembling the adult in most particulars; shape about the same; with far fewer quinquelocular disk pores accompanying the marginal 8-shaped pores; no multilocular disk pores; presence of minute simple pores and of minute dorsal 8-shaped pores not certain; ventral submarginal row of minute 8-shaped pores developed, but the pores much less numerous than in adult; anal region practically identical.

*Larva*.—Elongate elliptical to slightly ovoid, narrowed behind, length as mounted  $340\mu$ , width  $185\mu$ ; antennae 6-segmented; legs not unusual; spiracles not unusual, with one large quinquelocular disk pore at margin opposite each and a smaller one halfway between; with four to six fairly evident setae along anterior margin and a ventral submarginal row of minute setae on the abdomen, at least; 8-shaped pores in marginal and submedian rows on each half

of body as figured, but with only the one or two anterior pores of the intermediate rows developed; with a ventral submarginal row of very minute 8-shaped pores; anal setae about  $55\mu$ , inner seta of lobe about  $9\mu$ , anal ring seta about  $11\mu$ ; inner face of anal lobes and a band around anal ring chitinized.

*Cotype*.—Cat. No. 40360, U.S.N.M.

The precise relationship of this species to the remaining members of the genus *Asterolecanium* is not certain. From the study made thus far it seems, superficially at least, to be most nearly related to such species as *miliaris* Boisdual, *delicatum* Green, and *masuii* Kuwana.

It is highly probable that some of the Australian collections assigned to this species actually represent really distinct, although closely related, species. The only records that can be regarded as unequivocal are those of collections from leaves of *Styphelia richiei* from Victoria.

As already remarked, a portion of the Maskell material actually represents a distinct species which is characterized separately.

ASTEROLECANIUM TRANSVERSUM, new species

Plate 3, figs. 1, 4; Plate 27, fig. 3

*Habit*.—Living on the bark of the host.

*Adult female*.—Character of test and external appearance of insect not certain; body of fully distended adult, as mounted, slightly wider than long, length about 1 mm., width about 1.2 mm.; derm membranous; antennae reduced to short blunt cones, each with three to four setae at apex; legs wanting; spiracles not unusual, each with a row of quinquelocular disk pores running to margin, and normally including from 12 to 16 pores in each; beak very short conical, 1-segmented; with an occasional minute ventral submarginal seta, and with a few in the genital region, but no others observed on body; 8-shaped pores in a definite and conspicuous single marginal row interrupted only in the anal region; with a few very minute 8-shaped pores scattered on the dorsal surface and with a submarginal ventral row of similar pores, but these rather less definitely evident than in *stypheliae*; with a single row of quinquelocular disk pores accompanying the marginal row of 8-shaped pores, closely approximating these in number, and, in contrast to the usual condition, with one or two quinquelocular pores extending beyond the 8-shaped pores at the posterior end; multilocular disk pores present on the ventral surface of the abdomen in six median transverse segmental rows, with one or two additional pores near the lateral margins of the segments anterior to those bearing the rows; tubular ducts not particularly numerous nor conspicuous, more abundant toward the

margin of the body; no tiny simple pores definitely observed; anal region very slightly protruding, anal lobes broad, hardly differentiated, inner faces somewhat chitinized, usually with a small ventral thickening; ring somewhat invaginated and with a narrow collar above; anal ring with pores and six setae, these about  $32\mu$  long; apical seta more than  $50\mu$  long, one moderately stout seta within apical seta about  $10\mu$ , and two slender ones below it about  $6\mu$  long.

*Larva* (Embryonic).—Very similar to that of *styphehiae*, but with the intermediate row of 8-shaped pores on each half of the body nearly or quite complete, instead of almost wholly lacking as in *styphehiae*.

Described from a very few mounted specimens taken from the Maskell collection material. The original collection source of these specimens is uncertain and could not be determined from Maskell's descriptive notes. It seems at least a possibility that these specimens may represent the Tasmanian material which Maskell assigned to the species *styphehiae*.

*Holotype and paratypes*.—Cat. No. 40361, U.S.N.M. Paratypes also in Maskell collection of Coccidae located with the New Zealand Department of Agriculture.

The species is evidently very closely related to *Asterolecanium styphehiae* Maskell. It appears to differ definitely in certain respects, including the distinctly broader test and body, the larger number of quinquelocular disk pores in each of the rows between spiracles and margin (from 12 to 17 instead of from 6 to 9), and in the reduction in the extent of the chitinization on the anal lobes.

ASTEROLECANIUM VENTRUOSUM (Maskell)

Plate 3, figs. 2, 3, 5-13; Plate 27, fig. 4

*Reference*.—Fernald, Cat. Cocc. World, 1903, p. 54.

The Maskell collection contains four slides labeled as this species, one of "3 adult females, 1894," one of "adult female, 1894," one of "test of female, 1894," and one of "larva, 1894." The larva is quite plainly an Eriococcine form, and consequently can be given no further consideration. The remaining slides are in fair condition, so that it has been possible to check them against mounts which have been made from the unmounted specimens included in the collection under No. 423. Two species are very evidently present of which that described by Maskell as being on dark red bark and having a test with pinkish fringe, since it is mentioned first, is to be taken as the true *ventruosum* and the specimens from such bark as the type specimens. The description which follows is restricted to these specimens.

*Adult female*.—See Maskell publications for description of test and other points in the external appearance; body, as mounted, ap-



proximately circular, diameter 0.7 mm.; the anal region very slightly protruding; body entirely membranous except, as described later, in the anal region; antennae represented by flat conical stubs, each with a lateral, acute tip, and a central clear area bearing two pores and a single stout tapering seta; legs wanting; spiracles stout, somewhat kidney-shaped, each with a single row of tiny quinquelocular pores between it and margin; mouth parts not unusual, the segmentation of the beak obscured; with an occasional marginal, or perhaps ventral submarginal, slender seta, these more evident near the posterior apex of the body, and with segmental pairs of larger, stouter setae ventrally anterior to the anal region; large 8-shaped pores in a double row of alternating pores for about five-sixths of the circumference, the remainder near the anal region, in a single row terminating on each side somewhat before the apical seta; no other 8-shaped pores of comparable size present, but the dorsal surface with a very considerable number of minute 8-shaped pores, each not more than one-fourth the length of a similar marginal pore, scattered, apparently uniformly, over the surface, ventrally with a submarginal row of scattered minute 8-shaped pores of modified shape, shorter oval and less distinctly bilocular; quinquelocular pores represented by a marginal row, accompanying the 8-shaped band and, in general, nearly as numerous as the combined rows of 8-shaped pores anteriorly but about half as numerous near the posterior apex of the body, by a single to double row of scattered pores between each spiracle and margin, and by two or three just anterior to each antenna; multilocular disk pores each with 9–11 loculi in seven transverse, apparently segmental rows in the ventral abdominal region, the pores in the posterior rows closely placed, those in the anterior rows much more scattered; with a marginal row of minute, circular, apparently simple, disk pores immediately below the row of quinqueloculars and somewhat less abundant than these; relatively large tubular ducts present, rather numerous, distributed nearly uniformly through the dorsal area; anal area slightly protruding, the lobes not differentiated, anal seta stout, about  $165\mu$  long, with a stiff seta about  $7.5\mu$  long immediately beneath and another about  $6\mu$  long within at the opening of the short, distinctly chitinized, invaginated tube surrounding the anal ring; this last well developed for the genus, with pores and six setae, the longest about  $28\mu$ .

No other stages available from the type material.

*Cotype*.—Cat. No. 40362, U.S.N.M.

As with the other Maskell species of *Asterolecanium*, an accurate location of this species within the genus is not practicable at this time. From descriptions it seems probable that it is rather closely related to *A. tokyonis* Kuwana.

## Genus CALLOCOCCUS Ferris

*References.*—Ferris, Can. Ent., vol. 50, 1918, p. 328.—Morrison and Morrison, Proc. U. S. Nat. Mus., vol. 60, art. 12, 1922, p. 32.

As a consequence of the present study on the Maskell collection of Coccidae, the writers have been successful in removing two more species from Maskell's scrap-bag genus *Sphaerococcus*, and in attaching them, tentatively, at least, to this already described genus in the subfamily Asterolecaniinae. These two are the *Sphaerococcus acaciae* of Maskell and the *Sphaerococcus leptospermi* of Maskell. In habit characteristics these two differ widely from the genotype and from one another, but they appear to have much the same general morphological characteristics, possessing as they all do a definite median longitudinal dorsal compound pore band running from antennae to anal ring. The inclusion of these two additional species makes desirable some modification of the generic diagnosis previously given by the writers for *Callocooccus* (reference cited), and a revised diagnosis is accordingly given below:

Asterolecanine coccids with adult female with varying habit characteristics, inclosed in a waxy test, covered by a mass of white cottony secretion, or forming a swollen twig gall; body a sac, stout to elongate-elliptical in outline; derm membranous or more or less chitinized in the median dorsal area; antennae reduced to short stubs or to flat plates; legs wanting; beak short conical, 1-segmented; spiracles with short wide bar and a few quinquelocular disk pores adjacent; derm pore types including bilocular 8-shaped pores, all of small size, quinquelocular disk pores, possibly some pores with a greater number of loculi, tubular ducts with cup-shaped inner ends, and sometimes, at least, minute circular, apparently simple disk pores, the arrangement of these various, but a dorsal median longitudinal compound band, made up of two or more of these types and running from antennae to anal ring, characteristic of the genus; body with short stiff setae, these never numerous nor conspicuous, not differentiated into marginal, spiracular, dorsal and ventral types; anal region wholly undeveloped, the anal ring a small, simple collar placed ventrally some distance from the nominal posterior body margin; apical setae somewhat larger than remainder, placed between ring and margin.

Assumed second stage female elongate ovate; derm membranous; antennae stout, strongly tapering from base to apex, 6-segmented; legs stout and short, claw long slender or short and stout; beak stout conical, 1-segmented; derm with dorsal, ventral and marginal rows of setae; no spiracular spines differentiated; derm without pores other than the quinquelocular disk pores adjacent to the spiracles, or

with tubular ducts; anal region very slightly developed, the ring a simple collar with short internal tube, apical setae somewhat differentiated.

Larva dimorphic, normal form elliptical; antennae 4 to 6 segmented; legs normal; beak short conical, 1-segmented; spiracles not unusual, accompanied by one or more quinquelocular disk pores, 8-shaped pores in a marginal only or marginal and incomplete intermediate rows, no submedian row; no other pore types developed; anal region practically undeveloped, anal ring a small simple collar, apical seta differentiated, short or long; dimorphic form quite similar to that stage here regarded as second stage female.

CALLOCOCCUS ACACIAE (Maskell)

Plate 4, figs. 1-10; Plate 5, figs. 1-9; Plate 27, fig. 5

*Reference.*—Fernald, Cat. Cocc. World, 1903, p. 85.

The Maskell collection possesses five slides of this species, one of "female with larvae, 1892," two of "adult female, 1892," one of "2nd stage females and larva, 1892," and one of "larva, 1892." None of these is particularly good. There are also several unmounted specimens, attached to the host twigs, under No. 282. Additional specimens, apparently representing this species, collected in New South Wales by Mr. George Compere, have also been examined.

*Adult female.*—External appearance and secretion as described by Maskell, and as figured here; body as mounted very broadly elliptical, length about 2.7 mm., width about 2.5 mm.; derm membranous or faintly chitinized and indistinctly areolate over the mid-dorsal area at maturity; antennae represented by flat or very slightly protruding plates, each normally bearing three or four stout setae and one or two pores; legs lacking; spiracles stout, with short broad bar but only a few (around half a dozen) quinquelocular disk pores near opening; beak uncertain; body setae chiefly, and perhaps wholly, confined to the limits of the pore band, not conspicuous, stiff, around  $10\mu$  long, the two probably corresponding to the apical setae about  $18\mu$  long; no differentiated marginal setae; no spiracular spines; 8-shaped pores, so far as observed, restricted to the median longitudinal dorsal pore band, in this species much broadened and occupying fully a third of the dorsal area, and to a few in the region of the genital opening ventrally, small but numerous, with a fairly thick wall and a delicate internal tube from the middle; tubular ducts, with cylindrical tube showing, under some conditions, a fluted wall and a quinquelocular appearance from the end view, and normal small quinquelocular pores intermingled with the 8-shaped pores to form the pore band, probably in definite pattern, but this not certainly determinable from the material examined; some other

tubular ducts, with delicate tubes and very long slender prolongations scattered elsewhere on the body; no multilocular disk pores, other than the quinqueloculars, observed; no tiny circular simple pores observed; anal region as in other species of *Callococcus*, the ring a small simple band placed ventrally, no lobes, their location suggested only by two larger setae, accompanied by several small ones.

*Second stage female* (assumed).—Body elongate ovate, somewhat broader before the middle, length of mounted specimen about 0.68 mm., width about 0.29 mm.; derm membranous; antennae short conical, broad at base but 6-segmented, the preapical with one, the apical with several short stout sensory setae; legs short and rather stout, the coxae of each pair widely separated, tibia and tarsus only incompletely separated, claw long and slender, slightly curved, claw digitules slender, much shorter than claw; spiracles fairly stout, with two or three quinquelocular disk pores adjacent to opening of each; beak short, stout conical; marginal setae not differentiated; no spiracular spines; with transverse segmental rows of rather elongate (about  $11\mu$ ) setae dorsally and with corresponding ventral rows of smaller, more slender setae; no 8-shaped pores observed; with transverse segmental rows of elongate tubular ducts; with no multilocular disk pores, and with quinqueloculars only adjacent to the spiracles; no tiny circular simple pores observed; anal region poorly developed, lobes not protruding, apical seta about  $22\mu$  long; anal ring simple, small, with short internal tube attached.

*Larva* (normal form).—Elliptical, length as mounted about  $340\mu$ , width about  $150\mu$ ; derm membranous; antennae rather stout but not tapering strongly, 6-segmented, the two apical with stouter sensory setae; legs normal in size, claw long, slender, slightly curved, claw digitules slender, slightly knobbed at apices, surpassing apex of claw; beak short conical, 1-segmented, with a double row of small marginal setae and with one or two other rows dorsally and ventrally; with several setae on the very slightly developed anal lobes, the apical very long, as much as  $180\mu$ ; 8-shaped pores rather deeply invaginated, in marginal and incomplete intermediate rows dorsally on each half of body, no submedian row present; a small quinquelocular disk pore adjacent to the opening of each spiracle; no other pore types observed; anal ring poorly developed, with a faint short tube attached internally, opening not quite apical. (Dimorphic form).—Closely resembling the second stage female, already described, but smaller, and lacking the tubular ducts present in that stage.

*Cotype*.—Cat. No. 40363, U.S.N.M.

This species digresses widely from the other two now included in the genus *Callococcus* in its habit characteristics, having, as it does,

a mass of white cottony secretion thickly covering and concealing it, while *pulchellus*, the genotype, has a definitely formed ribbed test, and the other species here assigned to this genus, *leptospermi*, is much larger in size and forms a conspicuous twig swelling, within which it lives. Morphologically the species is distinguished from *leptospermi* by the lack of minute simple pores in the dorsal band, as well as by the difference in size. From *pulchellus* it is distinguished by the broad, relatively very lightly chitinized dorsal pore band, a structure which in *pulchellus* is almost linear, except where tripled, and usually heavily chitinized.

CALLOCOCCUS LEPTOSPERMI (Maskell)

Plate 5, figs. 10-13; Plate 6, figs. 1-8; Plate 27, fig. 6

*References.*—Fernald, Cat. Cocc. World, 1903, p. 86.—Froggatt, N. S. Wales, Dept. Agr. Sci. Bull. 19, 1921, p. 11 (part).

The Maskell collection includes eight slides of this species, one of "female before gestation, 1893," one of "female at gestation, 1893," one of "female after gestation, 1893," one of "male pupa, 1893," one of "male, 1893," one of "males, 1893," one of "late larva, 1893," and one of "early larvae, 1893." None of these slides is at all satisfactory. There are some galls of the species under lot No. 301 and a male glued to a rectangle of black cardboard. Specimens identified as this species, received directly from Mr. Froggatt, have also been available for comparison, but these represent another species, so the descriptive notes that follow have been taken from the Maskell specimens.

*Adult female.*—External appearance and habit as described by Maskell; elliptical, size varying, specimen examined 9 mm. long by 6 mm. wide as mounted; derm membranous, or possibly more or less irregularly lightly chitinized at maturity; antennae reduced to unsegmented nearly cylindrical tubercles, slightly invaginated and bearing two or three stout setae at apex; legs lacking; beak small, short conical, segmentation uncertain; spiracles stout, with short, broad, somewhat expanded bar, with a cluster of small quinquelocular pores around the opening of each; without definitely differentiated marginal setae; without spiracular spines; with small stiff setae widely scattered both dorsally and ventrally, largest, except for some probably corresponding to the anal lobe setae, in the mid-dorsal line, precise arrangement not at all certain; 8-shaped pores all much modified, small, sometimes with three loculi in line, usually with heavy outer wall, apparently confined to a broad median longitudinal band or stripe running the full length of the dorsal surface and continued onto the ventral surface at each end, this band, made

up of pores of three sorts, corresponding closely in position and in general composition to that found in the genotype, *pulchellus*, although differing in details; tubular ducts, so far as can be determined, of one sort only, small, rather short, somewhat swollen at inner end and with deep asymmetrical cup, widely scattered over dorsal and lateral surfaces of body, and to an uncertain extent ventrally, but apparently wholly excluded from the dorsal longitudinal pore band; derm with small quinquelocular disk pores around spiracular openings as described, and with larger similar pores dorsally in two loose rows forming the borders of the longitudinal pore band; ventral surface anterior to anal ring with transverse rows of scattered small disk pores, each with a definite quinquelocular center surrounded by a band possibly, but, from the material at hand, not certainly containing small loculi in uncertain numbers, possibly around 10; no cribriform plates; with a rather dense cluster of very tiny, apparently simple, pores through the middle section, or the area a little behind the middle, of the dorsal longitudinal pore band, the numbers gradually decreasing anterior and posterior to the densest portion; anal region practically obliterated, no traces of lobes or of chitinization; anal ring placed ventrally, well anterior to the apical margin in mounted specimens, reduced to nothing more than a relatively minute chitinized collar; a few larger stouter setae between ring and posterior margin of body, one pair in particular, each about  $10\mu$  long, probably representing the apical setae.

No other stages available, except very poor embryonic larvae not suitable for description.

*Cotype*.—Cat. No. 40364, U.S.N.M.

This species is readily differentiated from the two others now placed in *Callococcus* by its gall-making habit, by its large size, and by the presence of a dense cluster of minute simple pores in the middle section of the dorsal pore band. Forming, as it does, gall swellings in the twigs of the host, it has very little resemblance to either the genotype with its definitely formed waxy test or the other included species *acaciae* with its dense mass of white cottony secretion.

It is necessary to call particular attention to the fact that this insect, as described by Maskell, is not identical with the *Sphaerococcus leptospermi* sent out by Mr. W. W. Froggatt to various coccidologists and redescribed by Prof. G. F. Ferris in 1919.<sup>2</sup> This insect, as pointed out by Professor Ferris, may perhaps agree sufficiently with Mr. Green's genus *Amorphococcus* so that it may be placed in it. As it is at present without a name it is described briefly and named as new elsewhere in this paper.

<sup>2</sup> Can. Ent. Vol. 50, 1919, p. 250.

## Genus CEROCOCCUS Comstock

No attempt is made in the following discussion of the Maskell species that have been placed in this genus to indicate critically their relationships to the remainder of the species assigned to *Cerococcus* nor their relation to the genotype, *Cerococcus quercus* Comstock. Some examinations of supposedly congeneric species have been made but no critical conclusions have been reached.

Certain of the species now included here have had somewhat varied careers. *C. bryooides* and *C. stellata*, for example, were originally placed in *Asterolecanium* (actually in *Planchonia*). Even more curious was the assignment of *C. paradoxus* and *C. indicus*, which Maskell regarded as anomalous members of the genus *Eriococcus*. The incorrectness of this placing was first noted by Mr. E. E. Green, who correctly demonstrated their relationship to the oriental and Australasian species of *Cerococcus*.<sup>3</sup>

## CEROCOCCUS BRYOIDES (Maskell)

Plate 7, figs. 1-15; Plate 8, figs. 1-8; Plate 28, fig. 1

*References.*—Fernald, Cat. Cocc. World, 1903, p. 58.—Froggatt, Agr. Gaz. N.S.Wales, vol. 26, 1915, p. 1056.

The Maskell collection includes four slides of this species, one of "adult female, 1893," one of "spinnerets and anal tubercles, 1893," one of "larvae after hatching, 1893," and one of "larvae, embryonic, 1893." These are all rather poor. From the unmounted material, included under No. 338, a single adult female has been secured. The limited Maskell material has been supplemented in the following description by several mounted specimens, collected in Fiji by Mr. Albert Koebele and by Mr. George Compere.

*Adult female.*—Test as described by Maskell, body as mounted practically as wide as long, with the posterior extremity protruding, total length about 1.9 mm., width, 1.8 mm.; derm membranous throughout, excepting inner faces of anal lobes and the small disks bearing the cribriform plates; antennae reduced to small unsegmented tubercles, slightly invaginated and bearing several stout sensory setae apically; legs lacking; spiracles with broad but only faintly chitinized bar, a narrow median section heavily chitinized; beak short conical, incompletely 2-segmented; no spiracular spines, marginal setae, as such, not evident, derm with an occasional minute seta dorsally and ventrally, these largest, but still quite small, ventrally in the region of the genital opening; 8-shaped pores numerous and conspicuous over the dorsal surface, in two distinct sizes, the larger with a maximum largest dimension of about  $21\mu$ , the smaller

<sup>3</sup> Green, Journ. Econ. Biol., vol. 5, 1910, p. 5.

with a long dimension of about  $10\mu$ , but both sorts varying somewhat in size, the larger continued on to the ventral face of the body opposite the spiracles, and arranged in a fairly definite pattern dorsally, although one rather difficult to describe but usually with an interrupted and incomplete row of large pores, each placed transversely, along the median line in the mid-dorsal area, and on each side of this large whorls or circular bands composed of large and small pores intermingled, each with its long axis at a right angle to the radius of an imaginary circle, outside of these circles, near and at body margin, with numbers of large and small 8-shaped pores irregularly disposed; ventral abdominal surface in genital region without circular loculate disk pores, but with small 8-shaped pores in transverse bands; tubular ducts rather numerous and widely distributed, but small and much less conspicuous than the 8-shaped pores; with a small cluster of tiny multilocular disk pores near each antenna and additional similar pores scattered over the ventral surface, and with a single row of quinquelocular disk pores running from each anterior spiracle to margin, and a cleft row, with the ends widely separated, from each posterior spiracle, the pores at inner end of each row definitely smaller than those at outer end; cribriform plates small, very roughly circular, set in small chitinized plates, often double, arranged in two paired groups, the anterior group on each side usually limited to two plates, the posterior comprising from two to four such plates, with three the number most frequently present; minute simple pores not certainly observed; anal lobes well developed, stout conical, each bearing an apical seta about  $180\mu$  long, two stout, curved, spinelike setae on inner face, the larger about  $32\mu$ , and three much smaller, short slender setae on outer face, outer margin of each lobe thickened below, inner face thickened and lightly but fairly distinctly irregularly areolate; anal ring with pores and eight setae, each about  $80\mu$  long; cauda short tapering, broadly rounded at tip and bearing one to several tiny teeth along margin of outer half.

*Intermediate female*.—Not available.

*Larva*.—Body, as mounted, elongated ovoid, broader before the middle, length about  $360\mu$ , width about  $180\mu$ ; antennae 6-segmented, total length around  $107\mu$ , slightly enlarged apically, third segment longest; legs not unusual, claw with denticle, both claw and tarsal digitules knobbed and exceeding claw tip; beak short conical, incompletely 2-segmented; spiracles not unusual, each with a single quinquelocular disk pore at opening and the anterior with one, the posterior with two well-separated quinquelocular pores at margin opposite the spiracle; marginal setae small and inconspicuous, alternating with the marginal 8-shaped pores, no spiracular spines; dor-



sal and ventral surface setae few, small, not conspicuous, a cluster of larger setae between the antennal bases ventrally; 8-shaped pores conspicuous, in complete submedian and marginal and a posteriorly incomplete intermediate row dorsally on each half of body, the pores in the submedian row the largest; no tubular ducts; no tiny simple pores observed; anal lobes only slightly protruding, apical seta as much as  $160\mu$  long, each lobe chitinized on inner and ventral faces, bearing two stout, somewhat curved setae on inner face and two small slender ones on outer upper face; anal ring with a single row of pores and six setae, each around  $32\mu$ , and with a pair of shorter setae immediately below the ring; cauda very short, much broader than long, the margin very broadly rounded or almost truncate.

*Cotype*.—Cat. No. 40365, U.S.N.M.

CEROCOCCUS FROGGATTI, new species

Plate 9, figs. 1-11

*Reference*.—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 1056.

From an extended comparison between the single adult female of *stellatus* available from Maskell's type material and a few specimens of a species of *Cerococcus* identified as *stellatus*, received from Mr. W. W. Froggatt, the conclusion has been reached that the latter specimens can be distinguished from Maskell's species by a few small differences that appear to be definite, on the basis of the very limited material studied. Even if the two are actually definitely proven to be distinct when an extended series of each has been studied, their very close relationship is a fact that should be particularly emphasized.

*Adult female*.—Test as described by Froggatt (reference cited). Very similar to *C. stellatus* (Maskell), no apparent definite differences in most structures, pore pattern seemingly identical, differing definitely, so far as has been determined, in that the ventral transverse rows of 8-shaped pores at the apex of the abdomen adjacent to the genital opening are accompanied by a few scattered multilocular disk pores of fair size, each with around seven to eight loculi and usually with bilocular center, in contrast to the apparent complete lack of such pores in *stellatus*; and in the occurrence of few quinquelocular disk pores in the bands running from the anterior spiracles to margin, the number in this form apparently not exceeding 90, in contrast to around 115 in *stellatus*.

*Larva*.—Very similar to that of *stellatus* in most details, but seemingly offering an even more conspicuous differentiating character than is exhibited by the adults: the cauda in *stellatus*, as described, relatively long and strongly protruding, with rounded apex; in this

species merely a rather narrow thickened band bearing one or two denticulae on each side.

This species has been characterized from a few mounted and unmounted examples received from Mr. W. W. Froggatt under his No. 91, and collected by him at Mittagong, New South Wales, on stems of *Helichrysum diosmifolium* (Compositae).

*Holotype and paratypes*.—Cat. No. 40366, U.S.N.M.

CEROCOCCUS INDICUS (Maskell)

Plate 28, fig. 2

*References*.—Fernald, Cat. Cocc. World, 1903, p. 77.—Green, Journ. Econ. Biol., vol. 5, 1910, p. 5 (as new).

The Maskell collection contains a single slide of this species, of "adult female, 1896" in fair condition and a few unmounted specimens on the host under lot No. 508. Specimens from the material on which Mr. Green based his description have also been available.

As Mr. Green's figures (reference cited) are quite satisfactory, no attempt is made in this paper to illustrate the species. Some additions to Green's detailed description are given below.

*Adult female*.—Fully distended, mounted adult female about 2 mm. in diameter, excluding the protruding apical portion of the abdomen; antennae unsegmented cones, the apex not invaginated; pores in spiracular to margin bands normally quinquelocular, not simple, the anterior bands with around 60 pores in each, the posterior bands split, with diverging halves as already described for *bryoides*; beak stout conical, 2-segmented; typical number of cribriform plates two in each anterior group and four in each posterior group; with a few multilocular disk pores scattered in the posterior ventral region, but no lateral clusters of these; inner and ventral faces of anal lobes with chitinized areas, the inner distinctly large areolate.

No stages other than adult female have been available.

*Cotype*.—Cat. No. 40367, U.S.N.M.

The procedure adopted by Mr. Green (reference cited) of regarding this form as an undescribed species does not appear to accord with the established rules of zoological nomenclature, and if these are followed, Maskell, as the first publisher of a name for this insect, must be credited with the authorship of the species.

This insect is separable from Maskell's Australian and Fijian species by several characters; none of the species from these regions that have been examined has more than a single pair of clusters of cribriform plates while this has two pairs of such clusters; the presence of rudimentary legs also serves to distinguish it from *bryoides*, and the split posterior spiracular pore bands from *paradoxus*. It approaches *stellatus* and *froggatti* most closely, but these,

in addition to possessing a single pair of cribriform plate clusters, have the dorsal whorls of 8-shaped pores less pronounced and have a larger number of quinquelocular pores in the anterior spiracular bands.

Green regards *hibisci* as its closest relative. His careful and elaborately illustrated work on the Ceylon species and his work on the other Indian species should supply a basis for separating *indicus* from the other species of the Oriental region.

CEROCOCCUS PARADOXUS (Maskell)

Plate 10, figs. 1-13; Plate 11, figs. 1-3; Plate 28, fig. 3

*References.*—Fernald, Cat. Cocc. World, 1903, p. 77.—Green, Journ. Econ. Biol., vol. 5, 1910, p. 51.—*Cerococcus auranticus* Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 1055.

The Maskell collection includes four slides of this species, two of "adult female, 1895," and two of "adult female, 1896," all in fairly good condition. The unmounted specimens, placed under No. 68, include a few on a cardboard square and a number on a portion of the host plant. Supplementary mounts have been obtained from this material, and it is largely from these that the following re-description has been prepared.

*Adult female.*—Test and body as described by Maskell and Froggatt; body of mature female, as mounted, nearly circular, except for protruding apex of abdomen, maximum length 2.2 mm., width 1.9 mm.; early adults smaller and distinctly longer than wide; derm membranous; antennae reduced to fairly elongate, incompletely 2-segmented tubercles, hardly invaginated at apices, but with several stout apical setae; middle and hind legs represented by stout curved spines set on flattened bases, but fore legs with only somewhat enlarged bases; spiracles stout, each with a relatively heavy band of quinquelocular pores (more than 200) running from spiracle to margin, those forming the posterior bands not split into two groups as in many other species; beak stout conical, incompletely 2-segmented; marginal setae, as such, apparently not developed; no spiracular spines; dorsal and ventral derm setae small and inconspicuous, those placed ventrally in the genital region somewhat larger and more evident; 8-shaped pores numerous, in two distinct sizes, the larger having a maximum long dimension of about  $22\mu$ , the smaller size with a long dimension of  $15\mu$  or less, the larger pores confined to an elongate cluster on each margin of the protruding posterior portion of the abdomen, and to clusters on each side of the bands of quinquelocular pores running from spiracles to margin, plus an occasional pore in or near the posterior mid-dorsal area; smaller 8-shaped pores widely distributed, showing to some extent

in the mid-dorsal area the circular arrangement so conspicuous a part of the pore design in some other species; quinquelocular disk pores present in four heavy bands between spiracles and margin, as already described, in small clusters near antennae and scattered widely over the ventral body surface; multilocular disk pores, usually with multiloculate centers present anterior to the genital opening in at least two or three transverse segmental rows of widely separated pores, each row ending in a small cluster of pores; tubular ducts quite numerous, but slender and not at all conspicuous; cribriform plates in two clusters only, each including two or, less frequently, three small, roughly circular plates, each set in protruding chitinized rim; no tiny simple pores observed; anal lobes well developed, tapering, often obscured through the retraction of the extreme apex of the body, the ventral and inner faces more or less chitinized, this area on the inner face large areolate, apical seta rather stout, about  $150\mu$  long, the two stout curved setae on upper face fairly elongate, about  $36\mu$ ; cauda tapering rather strongly, about  $55\mu$  long by  $70\mu$  wide, apex rounded; anal ring with a single row of pores and eight setae, each about  $83\mu$  long.

*Intermediate female*.—Not available.

*Larva*.—Very similar to this stage of other species; length as mounted about  $420\mu$ , width about  $200\mu$ ; antennae 6-segmented, the third longest; legs not unusual; beak short conical, fairly distinctly 2-segmented; marginal setae small, slender; no spiracular spines; 8-shaped pores large, in the usual two complete and one incomplete rows on each half of the dorsal surface; apical setae of the slightly protruding anal lobes about  $215\mu$  long, cauda fairly strongly protruding, with rounded posterior margin; anal ring with a single row of pores and six setae, each about  $32\mu$  long.

Specimens of the species *auranticus* Froggatt, sent by Mr. Froggatt to the United States Bureau of Entomology, have been compared with slides of Maskell's *paradoxus*, but no basis for separating the two on morphological characters has been discovered and they are here regarded as identical.

It should be noted that no original actual type Maskell slides were represented in the collection and there is therefore no absolute assurance that specimens from the type material have been examined at all. From his description and from other circumstances it seems reasonably certain that the species redescribed here is actually the *paradoxus* of Maskell.

The closest relative is the species *punctuliferus* Green, found on the same plant host. The two apparently differ in one respect only: in *paradoxus* the larger sized 8-shaped pores are confined to the sides of the protruding caudal portion of the abdomen and to clusters on each side of the four spiracular pore bands, with an occasional large

pore sometimes present in the mid-dorsal area; in *puntuliferus*, in addition to the clusters found in *paradoxus*, there are present large pores in two rows of circularly arranged groups in the mid-dorsal region and in transverse clusters before and behind the spiracular groups. In addition, there are fewer pores in each of the spiracular bands of quinquelocular disk pores.

CEROCOCCUS STELLATUS (Maskell)

Plate 11, figs. 4-9; Plate 12, figs. 1-9; Plate 28, fig. 4

*References.*—Fernald, Cat. Cocc. World, 1903, p. 58.—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 1056.

There is in the Maskell collection a single slide of an adult female in fair condition bearing No. 525. This number belongs to the species *bryoides stellata* according to Maskell's lot book, and supplementary mounted specimens from unmounted material with the same lot number likewise agree with this mount. In addition, examples received from Mr. W. W. Froggatt, collected at Mittagong, New South Wales, have been compared with the Maskell specimens, but are considered to represent a distinct species.

*Adult female.*—Test as described by Maskell; body as mounted nearly circular in outline, excluding the protruding caudal apex of the abdomen, total length around 2.2 mm., width around 1.8 mm.; derm membranous; antennae reduced to stout truncate unsegmented cones, each slightly invaginated and bearing several stout setae at apex; legs represented by flat conical plates, each with a distinctly developed, slightly curved claw protruding from its center; beak short conical, incompletely 2-segmented; marginal setae, as such, apparently not definitely differentiated; no spiracular spines; dorsal and ventral setae few, small and inconspicuous; 8-shaped pores more or less definitely segregated into two size groups with the long dimension of the larger as much as  $22\mu$ , and of the smaller as much as  $12\mu$ , but both showing much variability, more even than in *bryoides*, these pores intermingled and distributed over the dorsal surface and margins of the body much as in *bryoides*, but with the whorls decidedly less definitely developed; tubular ducts fairly numerous and widely distributed, but small and inconspicuous, length to cup about  $21\mu$ ; with bands of normally quinquelocular disk pores running from spiracles to margin, these with the bands from each posterior spiracle split and with the halves strongly diverging, often with two (anterior) or one (each posterior half) tiny slender setae at the outer end of the pore band, the numbers of pores in each anterior band around 115, in each posterior compound band around 120; ventral surface with a considerable number of small, scattered multi-ocular disk pores, often with obscurely bilocular center and usually

with around nine indistinct loculi; cribriform plates in two groups only, each group normally comprised of two small, roughly circular cicatrices, each bordered by a narrow, somewhat protruding chitinized rim; tiny simple pores not observed; anal lobes stout conical, definitely protruding, typically without 8-shaped pores on the lobes, with a long apical seta, about  $195\mu$  long, two stout setae on inner face each about  $25\mu$  long, and apparently three slender setae below and on outer margin; anal ring small, elliptical, narrow, with an incompletely double row of pores and six setae, each about  $70\mu$  long; cauda fairly long, tapering, apex rounded, length about  $45\mu$ , width at base about  $60\mu$ ; inner and ventral faces of lobes more or less chitinized, the inner face faintly areolate; with a pair of long stout and a pair of small slender setae beneath anal ring.

*Intermediate female*.—Not available.

*Larva*.—Very closely resembling the larva of *bryooides*, already described, except that the cauda is much longer and protrudes more strongly; various details are exhibited in the drawings.

*Cotype*.—Cat. No. 40368, U.S.N.M.

This insect is quite readily and quite definitely separated from *bryooides*, with which it was placed as a variety by Maskell, through the possession of much reduced legs, as described. From the other Australian species available for comparison, including *paradoxus* (Maskell) and *punctuliferus* Green, it may be distinguished by the split band of pores running from each posterior spiracle to two widely separated points on the body margin. The other species have only a single undivided band of quinquelocular pores between each posterior spiracle and margin. It can not be compared morphologically with Mr. Froggatt's *pyriformis*, as no specimens of this species are available for study.

#### Genus FRENCHIA Maskell

*Reference*.—Morrison and Morrison, Proc. U. S. Nat. Mus., vol. 60, Art. 12, 1922, p. 17.

The type of this genus has already been redescribed in the paper cited above. The only other species now assigned to the genus is considered below.

#### FRENCHIA SEMIOCCULTA Maskell

Plate 13, figs. 1-12; Plate 14, figs. 1-10; Plate 28, fig. 5

*References*.—Fernald, Cat. Cocc. World, 1903, p. 39.—Froggatt, Dept. Agr. N. S. Wales, Sci. Bull. No. 18, 1921, p. 159.

The Maskell collection includes five slides of this species, one of "larvae, 1894," one of "early adult female, 1894," one of "test of male pupa, 1894," one of "adult female at gestation, 1894," and one

of "male, 1894." These slides are not satisfactory. The unmounted material is placed under the lot No. 358. The Maskell and Froggatt descriptions should be consulted for descriptive information regarding the galls and other deformations produced by this insect. No supplementary slides of the female stages were obtained from the Maskell type material, but one female was secured from cotype material received through Professor Cockerell.

*Adult female*.—External appearance and size as described by Maskell; derm membranous throughout; antennae reduced to flat plates bearing some small setae; legs apparently wholly lacking; spiracles rather stout, with several quinquelocular disk pores near the opening of each; beak very short conical, 1-segmented; body with a few scattered setae, these in fairly definite segmental arrangement on the "tail," but in no case large or conspicuous; no spiracular spines; no evident marginal setae; 8-shaped pores, as in the genotype, very much reduced in size and inconspicuous, apparently not at all numerous; tubular ducts present, normal number and situation not certain; body with normally quinquelocular disk pores near the spiracles, with at least a few pores with a large number of loculi, but the actual types, number, and arrangement of the derm pores uncertain from the material available; no cribriform plates; minute simple pores not definitely located; "tail" well developed, though much shorter than in the genotype, sides nearly parallel, with rounded apex; anal ring situated close to apex of "tail," a simple, roughly circular, rather heavily chitinized ring, with a short internal continuation and a smaller ring; genital opening placed only a little anterior to the anal ring.

*Intermediate female*.—As mounted, stout oval with the ends somewhat narrowed; length 0.62 mm., width 0.52 mm.; derm membranous throughout; antennae reduced to flat plates bearing two small setae; legs wholly lacking; spiracles rather slender, each accompanied by from two to six normally quinquelocular disk pores; no other pore types observed; derm bearing a few small setae and a somewhat larger pair of apical setae; anal ring placed close to the posterior apex of body, simple, incomplete.

*Larva* (from Maskell slide specimens only).—Body as mounted elliptical or somewhat narrowed behind; derm membranous; antennae 6-segmented but rather short, the second segment somewhat the longest, the apical two with stouter setae; legs not unusual, the tibia apparently quite short; body with some minute setae and with an apical pair around one-fifth the body length; no spiracular spines; 8-shaped pores not particularly conspicuous, although quite evident, with only a submedian and marginal row on each half of body, the incomplete intermediate row often present lacking in this species;

disk pores adjacent to spiracles apparently normally trilocular; no other pore or duct types observed; anal region, so far as can be determined, quite undeveloped, no definite ring, no lobes, no stout setae, and so on, probably as in *casuarinae*.

*Cotype*.—Cat. No. 40369, U.S.N.M.

The material on which this redescription has been based is so very scant that the description must be regarded as tentative only. There are even some apparent discrepancies between the "tail" and the spiracles as sketched from the Maskell slide and from a cotype specimen received through Cockerell, and drawings from both are therefore presented. Aside from the difference in habit, as described by Maskell, this species and the genotype are distinguished very readily by the shape of the "tail," as was noted when *casuarinae* was recharacterized (reference cited under genus).

### Genus *LECANIODIASPIS* Targioni-Tozzetti

With five species out of a total of about 33 described, Maskell's contribution to this genus is of some importance, particularly as the species were derived from widely separated localities—Australia, Southwestern United States, and South Africa. The described members of the genus are at present so poorly organized that little more than suggestions can be offered as to the actual relation of Maskell's species to the other species of *Lecanodiaspis*.

#### *LECANIODIASPIS ACACIAE* (Maskell)

Plate 15, figs. 1-13; Plate 16, figs. 1-28; Plate 28, fig. 6

*References*.—Fernald, Cat. Cocc. World, 1903, p. 54.—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 760.

The Maskell collection contains four slides of this species, one of "adult female, 1892," two of "2nd stage females, 1892," and one of "larva, 1892." Unfortunately, all of these mounts are poor and the specimens considered to be second stage females are in reality late larvae. Besides, there is a quantity of unmounted material under No. 233 from which supplementary mounts have been obtained, and additional mounted specimens from material received from Australia through other sources have also been examined.

*Adult female*.—See Maskell and Froggatt references for descriptions of test and of external appearance of insect; body of female, as mounted, more or less distinctly broader than long, probably due to permanent distortion at oviposition, length about 2.5 mm., width about 2.6 mm.; derm entirely membranous except for appendages and anal structure; antennae present, about half developed, more or less distinctly 3 to 5 segmented, length about 80 $\mu$ , width about



30 $\mu$ , with a cluster of spines, including two or three stouter, at the apex; legs present as conical tubercles, each bearing a well-developed claw with denticle and digitules; spiracles small, placed rather near margin, the anterior and both halves of the split posterior bands of disk pores running to margin more than two wide; mouth parts not unusual, the beak apparently 1-segmented; marginal setae present, stout conical, spinelike, each set in a heavy basal collar, and each bluntly rounded at apex; spiracular spines present, in pairs, the anterior two on each side close together, the posterior two well separated, each more or less curved and sometimes with expanded apex, but usually nearly cylindrical, tapering slightly to a rounded apex, average length about 29 $\mu$ , with an occasional small slender dorsal seta set in flat base, with a few minute ventral setae near antennae and perhaps elsewhere, and with two conspicuously large (about 46 $\mu$ ), widely separated setae anterior to anal structure and, between these, a pair of smaller setae; also with a ventral marginal row of small slender setae; 8-shaped pores abundant, but all small, distributed uniformly over the dorsal surface in a single marginal row, an irregularly alternating double to triple row immediately below the marginal row, in small ventral clusters adjacent to spiracular spines, and, as more minute, somewhat modified pores, scattered widely over the ventral surface; tubular ducts present, distributed over the whole dorsal surface, somewhat more numerous near margin; quinquelocular disk pores confined to region between spiracles and spiracular spines, rarely with more than five loculi; multilocular disk pores, with 10-12 loculi, abundant ventrally in crowded transverse segmental bands posteriorly, but in more scattered single segmental rows anteriorly as far as the posterior spiracles, the rows extending practically from margin to margin; with a row of scattered tiny simple disks along the margin about midway between the single and double rows of 8-shaped pores and with others somewhat smaller, scattered over the dorsum and about as numerous as the 8-shaped pores; cribiform plates present, in the two rows characteristic of the genus, but relatively very small and inconspicuous, numbers in each row varying from four to seven; general composition of anal region as in other members of the genus; apical seta stout, about 26 $\mu$  long; dorsal transverse plate somewhat angulate, or notched behind, lateral plates each with a number of conspicuous, heavily chitinized, longitudinal folds or wrinkles, and near the inner posterior face, with three stout setae, each about 11 $\mu$  in length, and with four slender setae below at the junction of these plates; anal ring slender, with pores and 10 setae.

*Second stage female.*—Specimens believed to represent this stage of *L. acaciae* Maskell, but from other than the type material, have

been studied and illustrated. The figures should be adequate for the recognition of this stage, and no description is attempted.

*Larva* (embryonic).—As mounted, nearly uniformly elliptical or slightly narrowed behind, length about  $393\mu$ , width about  $232\mu$ ; antennae normally 6-segmented, the apical longest, the third next, total length about  $153\mu$ ; legs not unusual, claw long, with distinct denticle near apex, both pairs of digitules well developed, attaining about the same distance beyond the tip of the claw, all slightly knobbed at apices, those of tarsus actually longer and about twice as stout as those of claw; spiracles not unusual, with a single quinquelocular pore adjacent to each, anterior with three such pores leading to spiracular spines, posterior without additional pores; marginal setae slender spinelike, blunt at apices; spiracular spines stout, the anterior two adjacent, the posterior two well separated and about half the length of the anterior, dimensions about as follows, but variable, anterior  $7\mu$ , posterior  $4\mu$ ; with an occasional tiny dorsal seta in the posterior abdominal region; ventrally, at least in the abdominal region, with a submarginal row of tiny setae and a submedian row of much larger setae on each side; with the posterior submedian seta conspicuously larger, about  $152\mu$ ; 8-shaped pores present, relatively small, in longitudinal rows, at least in the abdominal region, one submarginal row ventrally.

*Cotype*.—Cat. No. 40370, U.S.N.M.

This species and the other Australian species available for comparison, including *convexus* Froggatt, *eucalypti* Maskell, *frenchii* Froggatt, and *melaleucae* Fuller, appear to form a legitimate group within the genus, characterized chiefly by the relatively minute size of the individual cribriform plates. It is not at present certain that any other species may properly be associated with these. This species differs from the related *eucalypti* of Maskell most obviously through lack of the mid-dorsal bands of larger 8-shaped pores present and forming a distinct cross dorsally in *eucalypti*, and through possession of a larger number of the much reduced cribriform plates, normally seven to each longitudinal row, in comparison with a normal of four to each row in *eucalypti*. In addition, the marginal setae are distinctly stouter and bluntly rounded at tips in *acaciae*.

LECANIODIASPIS ATHEROSPERMAE (Maskell)

Plate 17, figs. 1-8; Plate 18, figs. 1-13; Plate 29, fig. 1

*References*.—Fernald, Cat. Cocc. World, 1903, p. 54.—Froggatt Agr. Gaz. N. S. Wales, vol. 26, 1925, p. 761.

The Maskell collection contains two slides of "adult female, 1895," one of which is well prepared, but unstained. Several additional

specimens are included in the unmounted material of the species to which has been assigned the lot No. 500. The redescription which follows is based chiefly on supplementary mounts prepared from this unmounted material.

*Adult female*.—See Maskell and Froggatt references for descriptions of test and of external appearance of insect; body, as mounted, elliptical, longer than wide in early adult to stout, nearly circular or broader than long in mounted examples of old shriveled specimens, length and width of early adult 1.5 and 1.2 mm.; of old adult 1.6 and 1.8 mm.; derm membranous throughout; antennae fairly well developed, normally 8 to 9 segmented, about  $196\mu$  long, the three apical segments bearing stout sensory setae; legs wanting; spiracles not unusual in shape, size, or position, marginal setae fairly stout, with large bases, total length about  $10\mu$ , width of base  $7\mu$ , not numerous, not conspicuous, with two anterior spiracular spines, these conspicuously differentiated in size, one about  $70\mu$ , the other about  $35\mu$ , but with only a single posterior spine, this approximating the larger anterior in size, about  $70\mu$ , and with only a single band of disk pores leading from posterior spiracle to body margin, instead of the two diverging bands usually present; dorsal surface of body with a very few relatively large, short, stout setae, about  $9\mu$  long, and so approaching the marginal in size and appearance; ventral surface with a submarginal row of moderately stout setae immediately adjacent to the marginal row and about as long as the dorsal, with a pair of much larger setae anterior to the anal region, each about  $90\mu$  long, and with a few slender, delicate setae scattered elsewhere, more abundant in the genital region; 8-shaped pores of derm small, numerous and rather uniformly distributed dorsally, with a loose triple row along the body margin somewhat larger, largest at margin immediately adjacent to the ends of the spiracular pore bands, ventral submarginal area with still smaller 8-shaped pores, these apparently lacking over the mid-ventral area; tubular ducts large and numerous dorsally, although not so abundant as the 8-shaped pores; with several (up to seven) transverse segmental rows of multilocular disk pores, each pore normally with 10–11 loculi, ventrally on the abdomen; spiracular disk pores in a single band from each spiracle to margin, each normally with five loculi; with a few minute simple disk pores ventrally near margin; cribriform plates small but evident, not minute and inconspicuous as in *acaciae*, normally in two rows of four each; anal area as in other species but with the upper half of each plate distinctly imbricate-reticulate, the upper edge of each bearing two moderately stout setae about  $20\mu$  long; anal ring narrow, bearing eight setae; apical seta relatively conspicuous, rather slender, but  $110\mu$  long.

*Preadult female*.—In general resembling the adult female; smaller, body longer than wide; antennae normally 7-segmented; legs wanting; dorsum and margin with small 8-shaped pores; spiracular spines and spiracular disk pore bands as in adult; cribriform plates wanting; marginal setae rather inconspicuous; anal area not so well developed, but the plates showing imbricate-reticulate areas.

*Larva* (embryonic only).—Ovate, somewhat broader anteriorly, length  $320\mu$ , width  $210\mu$ ; antennae 6-segmented, apical somewhat the longest; legs not unusual; all body setae minute, marginal not evidently differentiated in appearance from the others; spiracular spines as in adult, two anterior on each side, one long, one short, one posterior, this also short, not elongate as in later stages; 8-shaped pores in submedian, intermediate and marginal rows on each half of body dorsally; tubular ducts not located; anal ring narrow with eight setae; anal plates areolate; apical setae perhaps one-third length of embryonic body.

*Cotype*.—Cat. No. 40371, U.S.N.M.

This insect is plainly associated with several other species in *Lecaniodiaspis* through having the upper, outer margins of the anal plates distinctly imbricate-reticulate or longitudinally long areolate for a varying depth. These associated species definitely include *baculifera* Leonardi from Java, *malaboda* Green from Ceylon, and *quercus* Cockerell from Japan. Perhaps some other species, known to the writers only through incomplete published descriptions, may also possess this conspicuous differentiating characteristic.

#### LECANIODIASPIS EUCALYPTI (Maskell)

Plate 19, figs. 1-17; Plate 20, figs. 1-11; Plate 21, figs. 1-13; Plate 29, fig. 2

*References*.—Fernald, Cat. Cocc. World, 1903, p. 55.—Froggatt, Agr. Gaz. N. S. Wales, vol. 26, 1915, p. 762.

There are four slide mounts of this species in the Maskell collection, as follows: One of "adult female, 1892," one of "antennae, 1892," one of "2nd stage female, 1892," and one of "larvae, 1892." A small quantity of unmounted material is included under No. 246. Supplementary mounts have been prepared from this, and additional specimens, collected on Eucalyptus in Australia by Mr. George Compere, have likewise been available.

*Adult female*.—See Maskell and Froggatt references for description of test and of body of female; early adult elliptical, distinctly longer than broad, length about 1.8 mm., width about 1.3 mm.; older examples somewhat broader; derm membranous throughout or becoming faintly chitinized posteriorly; antennae fairly well developed, about  $215\mu$  long, normally 6 to 8 segmented, the last three bearing elongate, but thick, slightly curved sensory setae; legs

present but poorly and faintly developed, elongate cones with the joints indistinctly, and claw poorly developed; beak short conical, 1-segmented; marginal setae rather short and stiff, each perhaps  $17\mu$  long, but not stout, few in number, and accompanied by a few somewhat smaller ventral submarginal setae; the two anterior spiracular spines placed together, at most only somewhat unequal in length, the longer about  $43\mu$ , posterior two on each side widely separated, approximately equal in size, about  $38\mu$  long; dorsal and ventral surfaces with a few tiny, slender setae, these longer below and most numerous around genital opening, the pair of much elongated slender setae usually found ventrally just anterior to the anal complex wanting or much reduced in size; with small 8-shaped pores scattered rather thickly and uniformly over the dorsal surface, with definitely but not conspicuously larger 8-shaped pores in one longitudinal and one transverse band dorsally forming a distinct cross, in a submarginal row joined at intervals to the margin and in a band along the margin, most of these larger pores somewhat invaginated; this arrangement most obvious in early adult females, rather obscured in the fully matured examples; tubular ducts elongate, slender, numerous, more abundant towards margin; multilocular disk pores present in eight transverse rows on the ventral abdominal segments, the anterior ones only a single pore wide, the posterior ones fairly broad bands, these mostly with 10 loculi; spiracular disk pores normally quinquelocular, those at margin distinctly larger than those near spiracle, the anterior band fairly wide, the posterior split, the halves running diagonally to each spiracular spine; tiny simple pores widely but sparsely distributed over the dorsum and at margin, apparently wanting ventrally; cribriform plates small and inconspicuous, resembling those of *acaciae*, normally in two rows of four each; anal area not peculiar, the plates heavily wrinkled and ridged but not areolate, with two stout setae near to but not on the upper margin of each, these about  $14\mu$  long, anal ring narrow, with 10 somewhat swollen setae with delicately produced tips, apical seta not differentiated from marginal, not very stout, short, about  $14\mu$  long.

*Preadult female*.—In general much as in adult, but less developed; amply figured in the illustrations accompanying the paper, so not described.

*Larva*.—Elliptical, length as mounted  $430\mu$ , width  $215\mu$ ; antennae 6-segmented, the apical longest, the three apical bearing stouter sensory setae, total length about  $165\mu$ ; posterior spiracular spines relatively inconspicuous, other structures as shown in figures; length of largest spiracular spine about  $8\mu$ ; anal plates faintly wrinkled but not areolate.

*Cotype*.—Cat. No. 40499, U.S.N.M.

The obvious differences between this insect and its nearest relative among the Maskell species, *L. acaciae*, have been pointed out under the discussion of that species.

LECANIODIASPIS MIMOSAE (Maskell)

Plate 22, figs. 1-17; Plate 23, figs. 1-13; Plate 29, figs. 3, 4

*Reference.*—Fernald, Cat. Cocc. World, 1903, p. 55.—Brain, Bull. Ent. Res., vol. 10, 1920, p. 116.

The Maskell collection contains three slides of this species, one of "adult female, 1896," one of "male pupa, 1896," and one of "larva, 1896," none of which are at all good. There is a small quantity of unmounted material under No. 533. Supplementary slides have been prepared from this, and the following redescription is based chiefly on these, with reference to additional South African specimens from other sources.

*Adult female.*—See Maskell and Brain references for description of test and of external appearance of the female; body, as mounted, short elliptical, length about 3.2 mm., width about 2.7 mm.; derm membranous throughout; antennae fairly well developed, normally 9-segmented, the terminal three with stouter, curved, sensory setae; legs present as tiny stubs or perhaps entirely wanting sometimes; spiracles set well in from margin, the disk pore bands correspondingly elongate; beak short conical, 1-segmented; marginal setae rather slender, about  $18\mu$  long, few in number; anterior spiracular spines present, relatively elongate, and slender, approximately equal in length, about  $62\mu$  long, the ends often clavate, but variable; pore band from posterior spiracle split and diverging, but the spines apparently normally lacking, from the few specimens examined; with a few small, slender scattered dorsal setae perhaps  $10\mu$  long, with similar small scattered ventral setae, more numerous and larger in the genital region, the long pairs before the anal complex poorly developed, only about  $36\mu$  long; with numerous small 8-shaped pores distributed nearly uniformly over the dorsal surface, becoming larger and more crowded at the margin, but not forming a distinctly set-off marginal band, also continued onto the ventral surface, but again as small pores, as far towards the middle line as the spiracles; tubular ducts numerous dorsally, slender and quite elongate, somewhat more abundant towards margin; multilocular disk pores in seven rows or bands across the ventral surface of the abdomen, the posterior bands containing numerous pores, the anterior very attenuated, obscure, including relatively few, scattered pores, these all normally with 10 loculi; spiracular disk pores normally quinquelocular, forming a single band from anterior spiracle to margin, but a branched or diverging double band from the pos-

terior to margin; cribriform plates approximately circular, relatively large and conspicuous, densely pitted, normally in two longitudinal rows of five each; tiny simple pores distributed sparsely but fairly uniformly over the dorsal surface and to some extent along the margin ventrally; anal region not unusual, the plates rather heavily ridged and wrinkled, with two moderately stout setae near the outer end of each plate and at about its middle dorso-ventrally, these about  $18\mu$  long, each anal plate with from one to three or four small circular pores; apical seta moderately elongate, stout, length about  $60\mu$ ; anal ring with 10 setae, length of one about  $125\mu$ .

*Preadult female*.—In general resembling the adult; legs more evident, antennae with fewer segments, spiracular grooves with fewer disk pores, the anterior with two elongate spines at margin, the posterior split into two diverging rows but without spiracular spines, as in adult; anal ring with eight setae.

*Larva*.—Elliptical or somewhat tapering behind, length about  $430\mu$ , width about  $230\mu$ ; antennae as in other species, legs not unusual; marginal setae short, not stout, with a pair of small anterior spiracular spines on each side, the posterior ones wanting as in adult; with a few minute setae dorsally and ventrally; 8-shaped pores in a submedian, intermediate and marginal row on each half of the body, and in a ventral submarginal row, these last much smaller than the dorsal pores; with a few (two to four) normally quinquelocular disk pores between spiracles and body margin; ventral surface of abdomen with one pair of much more elongate slender setae anterior to the anal plates; anal plates wrinkled, each bearing a single moderately stout seta near apex; anal ring with six setae; apical seta quite elongate.

*Cotype*.—Cat. No. 40372, U.S.N.M.

The apparently normal absence of the posterior spiracular spines in this species seems to be a noteworthy, and perhaps a distinctive structural feature.

LECANIODIASPIS PROSOPIDIS (Maskell)

Plate 24, figs. 1-20; Plate 29, fig. 5

*Reference*.—Fernald, Cat. Cocc. World, 1903, p. 55.

There are five slides of this species in the Maskell collection, three of "adult female, 1894," one of "antennae of female, 1894," and one of "abdomen of female, 1894." These are in fair condition only. Some unmounted specimens are included under No. 417. The following redescription is based on mounts prepared from this, supplemented by specimens collected by Dr. E. A. Schwarz in 1897 at Tuscon, Ariz., on *Prosopis*.

*Adult female*.—See Maskell paper for description of test; body as mounted as much as 2.6 mm. long by 2.2 mm. wide, usually ovoid, somewhat broadened behind the middle; derm membranous throughout; antennae fairly well developed for the genus, normally 8-segmented; length about  $230\mu$ , some, at least, and probably all of the legs present as short poorly developed stubs; spiracles stout but not large, set well in from the margin, the anterior joined to margin by pore band about three pores wide, the posterior with a split and diverging double band reaching the margin at two points and each portion about one to two pores wide; beak stout conical, 1-segmented; marginal setae apparently very few, actually definitely observed only near posterior apex of body, here slender, rather elongate, about  $17\mu$  long; with the two anterior spiracular spines on each side closely associated, approximately equal in length, measuring from  $29\mu$  to  $40\mu$  in length, variable in shape, sometimes somewhat clavate, usually more nearly cylindrical, usually slightly curved, posterior two on each side well separated from each other, resembling the anterior in size and shape, but usually a little shorter, around  $28\mu$  to  $36\mu$  long; with an occasional small dorsal seta, these, however, apparently quite rare, and ventrally with an occasional small stiff seta, and, in the region of the genital opening, several elongate, slender setae with one pair anterior to the anal plates still longer but very slender and not at all conspicuous, perhaps  $48\mu$  long; 8-shaped pores, although small, fairly numerous and rather uniformly distributed dorsally, definitely, though not conspicuously larger towards and at margin, these last bounded in the submarginal ventral area by a fairly distinct loose double row of smaller 8-shaped pores each definitely aligned along the axis of the row; and with much smaller obscurely 8-shaped pores scattered between this band and spiracles; tubular ducts rather numerous, approximately uniformly distributed dorsally, somewhat more abundant towards margin, of moderate size; abdominal disk pores, normally with 10 loculi each, in eight definite transverse rows with traces of a ninth visible, the three posterior actually clusters or bands of pores, the remainder single rows, these much attenuated anteriorly; spiracular disk pores normally quinquelocular, the anterior band entire, the posterior split, the two parts diverging to the margin; tiny simple pores scattered fairly uniformly over dorsum, not numerous; cribriform plates normally in two rows of three each, roughly circular, longest diameter around  $25\mu$ – $28\mu$ , surface somewhat convex medially, finely and closely areolate; anal plates, as flattened on slide, triangular, ridged and wrinkled, bearing two relatively large setae near middle line, well away from upper margin, each of these about  $21\mu$  long, and one to three tiny pores, without setae, on the posterior margin of the bar joining them below; anal ring narrow, with pores and 10 setae each



around  $110\mu$  long; apical setae fairly large and stout, about  $82\mu$  long.

*Preadult female*.—No examples of this or other intermediate stages available.

*Larva*.—Ovoid, slightly broader before the middle, length about  $520\mu$ , width about  $270\mu$ ; antennae 6-segmented, about  $180\mu$  long, terminal longest, last three with stouter curved sensory setae; legs not unusual; beak short conical, 1-segmented; marginal setae slender, about  $7\mu$  long, spiracular spines apparently variable, the anterior usually in twos,  $3-6\mu$  long, posterior apparently single, perhaps sometimes wanting or very short, perhaps  $3\mu$ , or resembling the marginal; with a few minute setae dorsally and ventrally; 8-shaped pores in submedian, intermediate, and marginal rows on the anterior portion of body, the intermediate row lacking on the abdomen; anal plates poorly developed, each bearing a single moderately stout seta; anal ring narrow, with pores and six setae; apical seta elongate, about  $225\mu$ .

*Cotype*.—Cat. No. 40373, U.S.N.M.

This species is a member of a very complex and very difficult group within the genus, probably now comprising a total of 10 described North and South American species. The actual status of all these supposedly valid species is uncertain at this writing; however, *prosopidis* may apparently be separated from all of those described from North America by at least one definite morphological character. All of the adult females of *prosopidis* that have been examined have only three cribriform plates in each of the two rows. All of the other North American species appear to possess four or five of these structures in each row.

#### Genus SOLENOCOCCUS Cockerell

*Reference*.—Morrison and Morrison, Proc. U. S. Nat. Mus., vol. 60, art. 12, 1922, p. 21.

Studies on related genera and species, particularly on the genus *Cerococcus*, have not progressed sufficiently to establish definitely the status of this genus and it is therefore left without change in this paper, although there seems to be much evidence to indicate that at least the two New Zealand species included here can hardly be separated generically on a morphological basis from the Australian and Fijian species that are currently assigned to the genus *Cerococcus*. The genus *Solenococcus* as now accepted is actually based on the development of a posterior apical protruding tube on the test of the adult female. Such a character can hardly be considered as having generic significance, particularly as an exactly parallel condition has been accepted in the genus *Asterolecanium* without a suggestion that the

species whose test possesses such a tube should be segregated into another genus. The genotype species *S. fagi* (Maskell) has already been redescribed (reference cited above), and a redescription, with figures, is given below for Maskell's other included species.

SOLENOCOCCUS COROKIAE (Maskell)

Plate 25, figs. 1-11; Plate 26, figs. 1-10; Plate 29, fig. 6

*Reference*.—Fernald, Cat. Cocc. World, 1903, p. 58.

The Maskell collection includes three slides of this species, one of "adult female, on *Corokia cotoneaster*, Sept., 1889," one of "female, 2nd stage, Apr., 1890," and one of "male, Feb. 7, 1890." There is also a small quantity of unmounted material under No. 110.

*Adult female*.—See Maskell description for information regarding the character of the test inclosing the insect; body, as mounted, stout oval to nearly globular, somewhat narrowed posteriorly and with apex of abdomen protruding slightly, length about 1.3 mm., width 1.1 mm.; derm membranous, excepting only the inner margins of the anal lobes; antennae short, stout, obscurely 2-segmented, tubercles bearing five or six setae at tip but not invaginated at apex; legs wanting; spiracles with slender bar and with a cluster of quinquelocular pores at one side of opening, these continued as an irregular row to the margin, those opposite the anterior spiracle terminating in a close cluster, the row totaling about 80, those opposite posterior spiracle forming two diverging rows terminating in two distinct, well-separated clusters at the margin; beak short, stout conical, incompletely 2-segmented; margin between dorsal and ventral surfaces not definitely indicated, but with widely separated slender setae in the lateral region possibly indicating the margin; spiracular spines wanting; with an occasional minute seta dorsally, and with these longer and larger over the ventral surface; 8-shaped pores abundant dorsally, varying considerably in size as indicated in figure, the larger pores more or less distinctly aggregated near the median line and along the margin, and 8-shaped pores also present ventrally on the posterior portion of the body in transverse rows accompanying the multilocular disk pores, remaining anterior portion of ventral surface with numerous and uniformly scattered, smaller, modified 8-shaped pores; tubular ducts numerous dorsally but not conspicuous, also occurring to some extent ventrally; quinquelocular pores in bands from spiracles to margin as already described, and, in addition, in a marginal band from the posterior spiracular band to the antenna on each side, multilocular disk pores in five long transverse rows in the ventral abdominal region, size varying somewhat, loculi varying from 6 to 10; with minute, simple chitinized circles, possibly pores, sparsely present over both surfaces; cribriform plates present, in two clusters of

six to eight each but the individual plates tending to coalesce, till so few as two grouped plates to a cluster may be present; anal region developed into two rather long conical lobes, each membranous except for inner face, this broadly chitinized at base and concave, the two thickenings forming a more or less distinct collar around anal setae, with a rather stout apical seta about  $78\mu$  long at end of each lobe and with two rather stout subapical and a submedian seta on inner face, each of these as much as  $21\mu$  long, and the ventral subapical much more slender than the others; each lobe with three 8-shaped pores; with a large and conspicuous median cauda, about  $50\mu$  long by  $60\mu$  wide at base, this tapering and rather distinctly angulate at apex; with two rather large and stout and, anterior to these, two much smaller setae below the anal ring; ring with pores and eight setae, the last about  $80\mu$  long; ventral abdominal derm tending to protrude beyond anal lobes.

*Larva*.—Ovoid, distinctly tapering posteriorly, length about  $230\mu$ ; antennae 6-segmented, the third the longest; legs slender, not unusual, claw very slender, with denticle near tip; both pairs of digitules present, exceeding claw, those of claw only slightly knobbed at apices; 8-shaped pores present, large and conspicuous, in three rows, marginal, submedian and intermediate on anterior portion of body but only the first two present posteriorly, caudal structures in general similar to those of adult, the same elements present, but less developed, anal seta about  $150\mu$  long; marginal setae small, not conspicuous; no traces of spiracular spines.

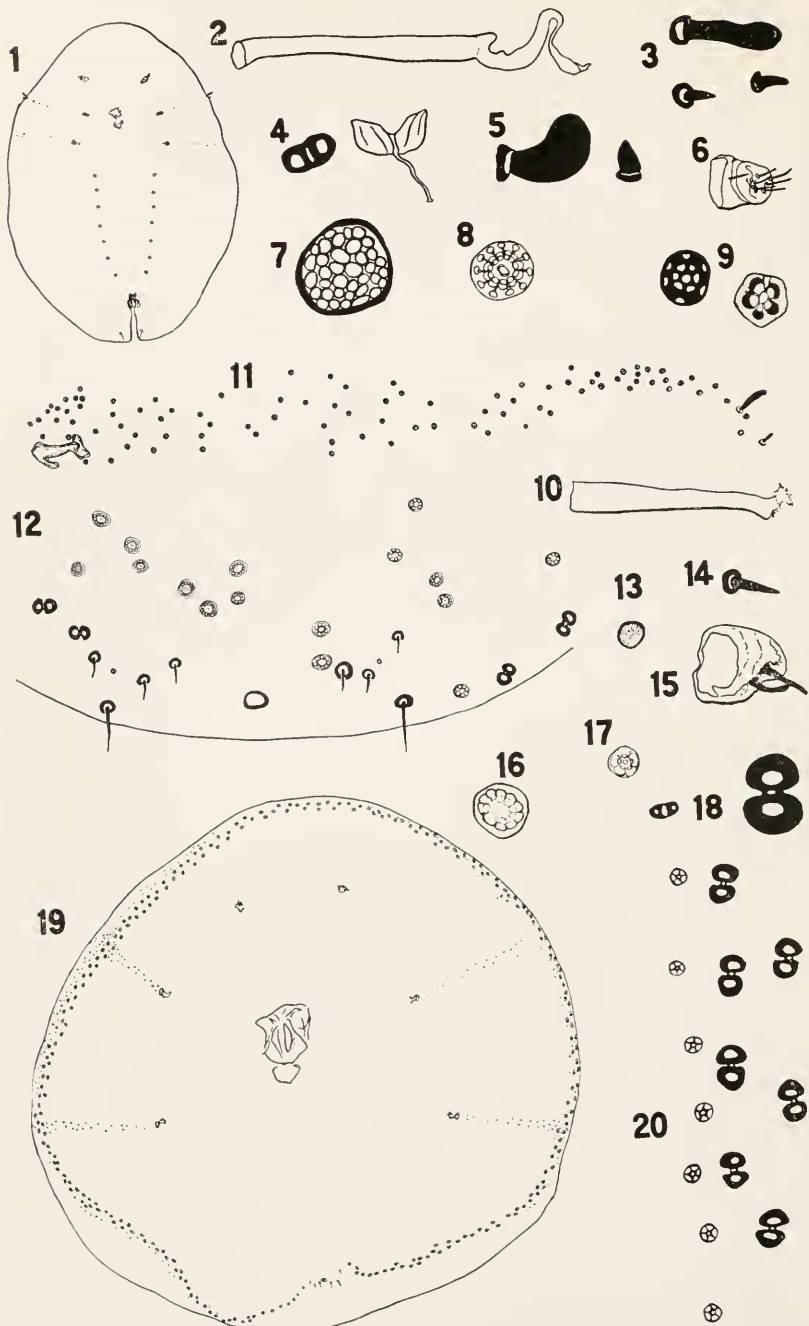
*Cotype*.—Cat. No. 40374, U.S.N.M.

The two New Zealand species of *Solenococcus* may be separated very readily by the condition of the cribriform plates. In *fagi*, four, grouped in two pairs, are present; in *corokiae*, while there are also only two groups, there may be as many as six plates in each of the groups, or if there is fusion, the plates may be quite elongate instead of roughly circular. These two species are differentiated from all of the Australian *Cerococcus* species through the absence of even aborted legs, resembling the Fijian *Cerococcus bryoides* in this respect. From this last, the two New Zealand species differ in individual details, *fagi*, while normally with four cribriform plates grouped in two pairs, lacking any large-sized 8-shaped pores in the mid-dorsal area, and *corokiae*, while possessing a limited number of these large pores in the mid-dorsal region, having a far smaller number than *bryoides* and normally having many more than two plates in each of the two cribriform plate clusters. The test of *bryoides*, with its conspicuous tufts of secretion, is, of course, strikingly different from the nearly smooth test of the two New Zealand species with the protruding apical tube.

#### EXPLANATION OF PLATES

The photographic illustrations shown on Plates 27, 28, and 29 are from negatives prepared by Mr. J. G. Sanders and Mr. J. G. Pratt as follows: Figures 1, 2, 3, and 4 of Plate 27; Figures 1, 4, and 6 of Plate 28; and Figures 1, 2, 3, 4, 5, and 6 of Plate 29 are from negatives made by Mr. Sanders; Figures 5 and 6 of Plate 27; and Figures 2, 3, and 5 of Plate 28 are from negatives made by Mr. Pratt.





MASKELL SPECIES OF ASTEROLECANIINAE

FOR EXPLANATION OF PLATE SEE PAGE 37

PLATE 1

*Amorphococcus leptospermi*, new species, adult female, except one, and  
*Asterolecanium acaciae*, new species, adult female.

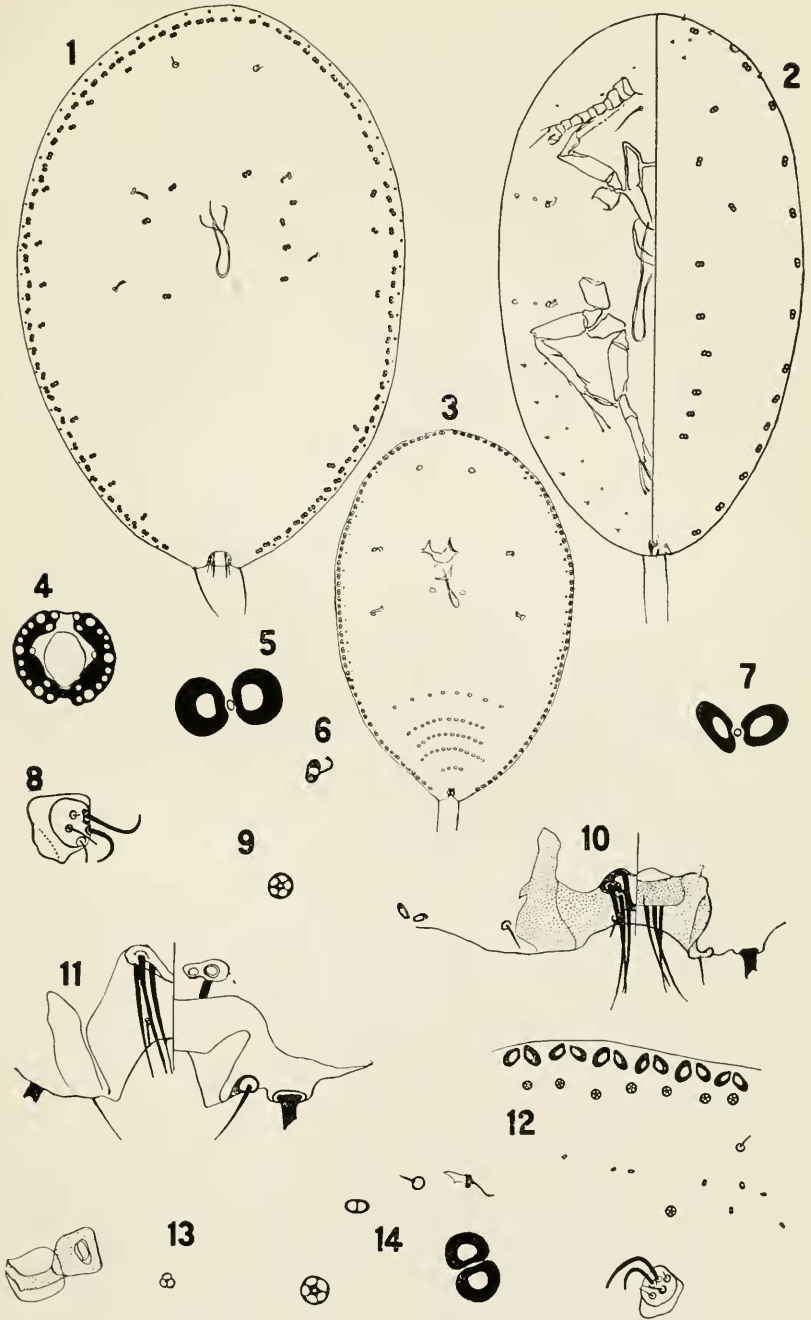
Figure 1. *leptospermi*, adult female, outline, optical section,  $\times 12$ ; 2, same, tubular duct,  $\times 1,280$ ; 3, same, spiracular spines, including a second smaller one to show variation in shape,  $\times 430$ ; 4, same, dorsal 8-shaped pore,  $\times 1,280$ ; 5, *leptospermi*, larva, anterior spiracular spines,  $\times 1,280$ ; 6, *leptospermi*, adult female, antenna,  $\times 230$ ; 7, same, single cribriform plate,  $\times 1,280$ ; 8, same, posterior ventral abdominal multilocular disk pore,  $\times 1,280$ ; 9, same, quinquelocular disk pores from spiracular band, showing variation in appearance under differing optical conditions,  $\times 1,280$ ; 10, same, anterior spiracle to margin quinquelocular pore band,  $\times 120$ ; 11, *acaciae*, adult female, tubular duct,  $\times 1,280$ ; 12, same, apex of abdomen, optical section,  $\times 115$ ; 13, same, spiracular quinquelocular disk pore,  $\times 1,280$ ; 14, same, subapical seta,  $\times 1,280$ ; 15, same, antenna,  $\times 650$ ; 16, same, posterior ventral abdominal multilocular disk pore,  $\times 1,280$ ; 17, same, marginal quinquelocular disk pore,  $\times 1,280$ ; 18, same, dorsal (left) and marginal (right) 8-shaped pores,  $\times 1,280$ ; 19, same, outline, optical section, showing particularly the condition of the marginal band of pores,  $\times 60$ ; 20, same, section of marginal pore band caudad of posterior spiracle,  $\times 650$ .

PLATE 2

*Asteroleccanium cpaeridis* (Maskell), adult female, and  
*Asteroleccanium styphcliac* (Maskell), larva and adult female.

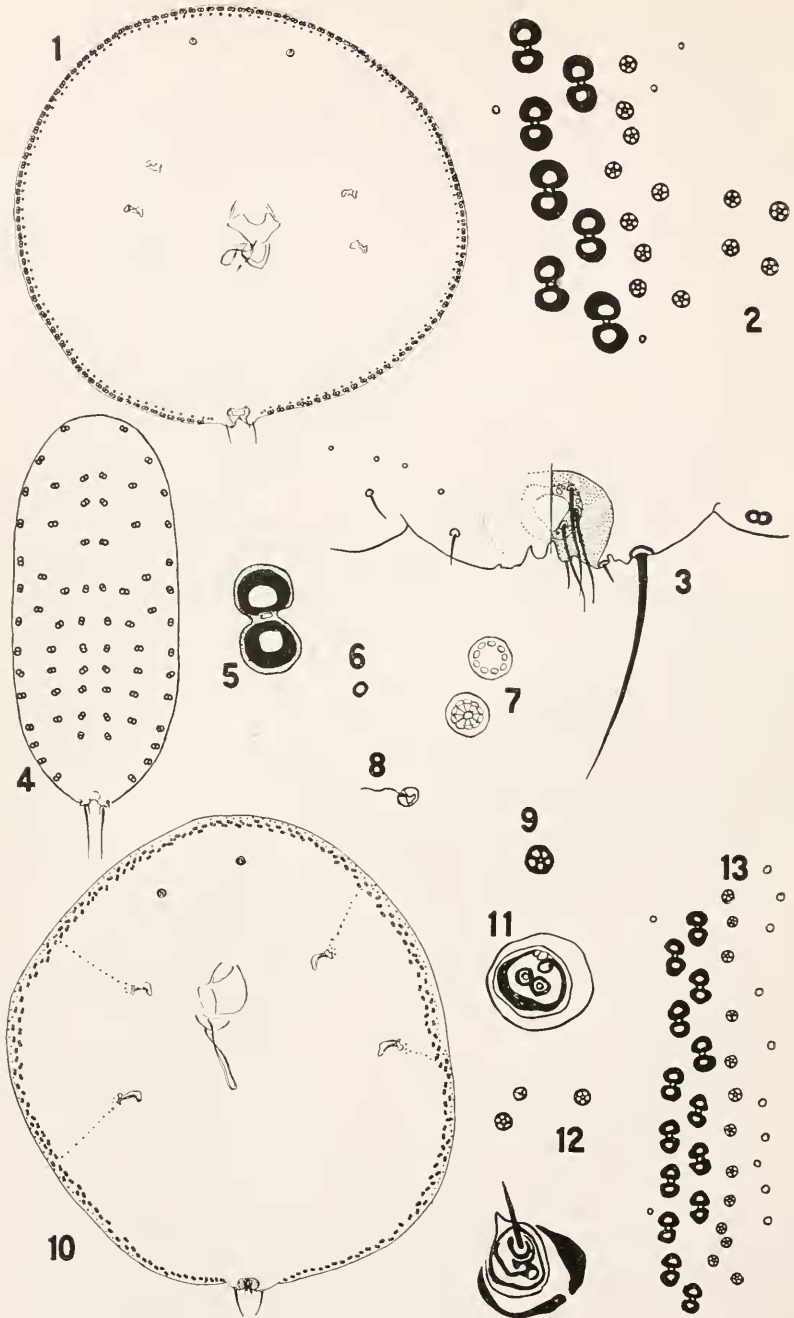
Figure 1, *cpaeridis*, adult female, outline, optical section,  $\times 115$ ; 2, *styphcliac*, larva, outline, dorsal and ventral,  $\times 230$ ; 3, *styphcliac*, adult female, outline, optical section,  $\times 115$ ; 4, same, anal ring,  $\times 820$ ; 5, same, marginal 8-shaped pore,  $\times 1,500$ ; 6, same, tiny dorsal 8-shaped pore,  $\times 1,500$ ; 7, same, another 8-shaped pore from marginal band,  $\times 1,500$ ; 8, same, antenna,  $\times 820$ ; 9, same, quinquelocular disk pore,  $\times 1,500$ ; 10, same, anal region, dorsal and ventral,  $\times 650$ ; 11, same, larva, posterior apex of body,  $\times 1,500$ ; 12, same, adult female, antenna and anterior margin of body,  $\times 650$ ; 13, same, larva, spiracle and adjacent pores,  $\times 1,500$ ; 14, same, larva, types of derm pores and seta,  $\times 1,500$ .





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PLATE 3

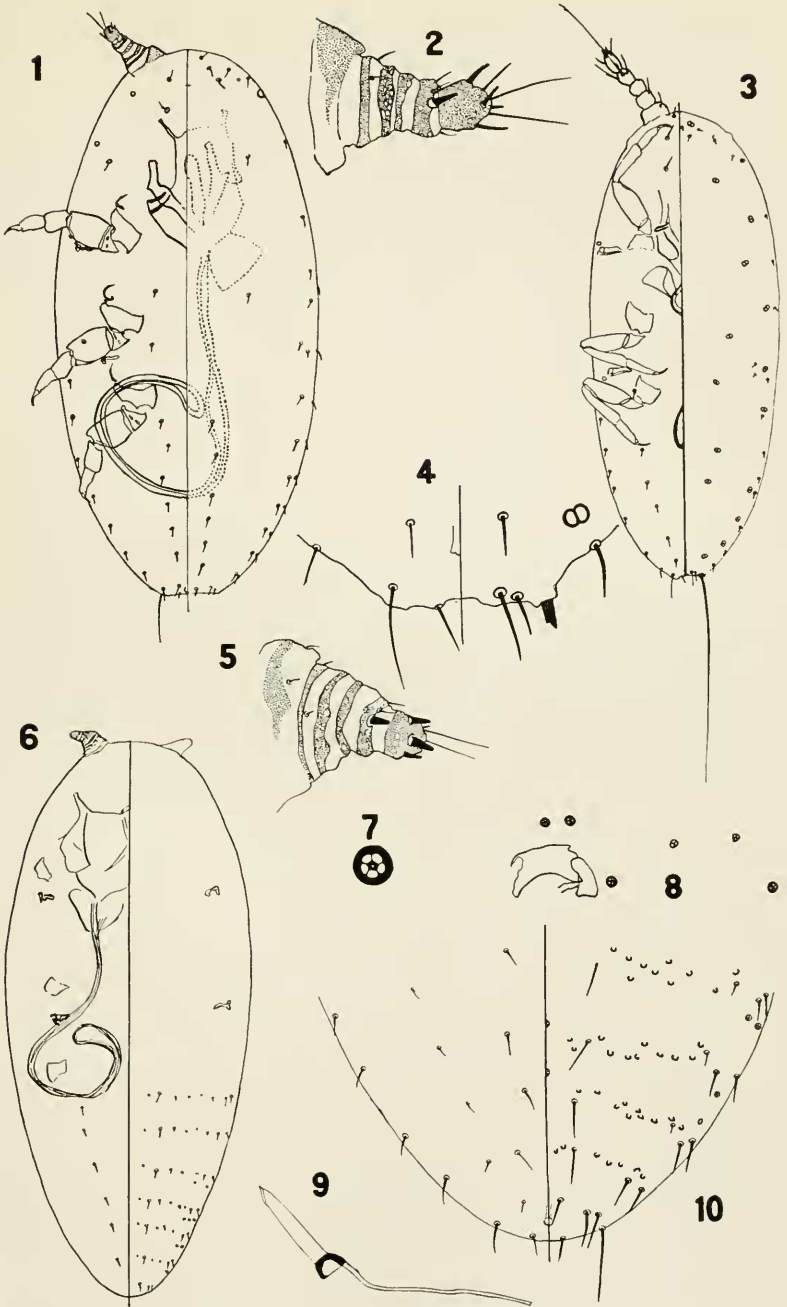
*Asterolccanium transversum*, new species, adult female and larva, and  
*Asterolccanium ventruosum* (Maskell), adult female.

Figure 1, *transversum*, adult female, outline, optical section,  $\times 90$ ; 2, *ventruosum*, adult female, marginal pores opposite posterior spiracle,  $\times 820$ ; 3, *ventruosum*, same, apex of abdomen, dorsal and ventral,  $\times 530$ ; 4, *transversum*, larva, outline, dorsal, showing pore arrangement,  $\times 230$ ; 5, *ventruosum*, adult female, marginal 8-shaped pore,  $\times 1,280$ ; 6, same, simple pore,  $\times 1,280$ ; 7, same, posterior ventral abdominal multilocular disk pores,  $\times 1,280$ ; 8, same, minute dorsal 8-shaped pore,  $\times 1,280$ ; 9, same, marginal quinquelocular disk pore,  $\times 1,280$ ; 10, same, outline, optical section,  $\times 90$ ; 11, same, antenna,  $\times 820$ ; 12, same, another antenna with adjacent disk pores,  $\times 820$ ; 13, same, portion of marginal pore band caudad of posterior spiracle,  $\times 430$ .

PLATE 4

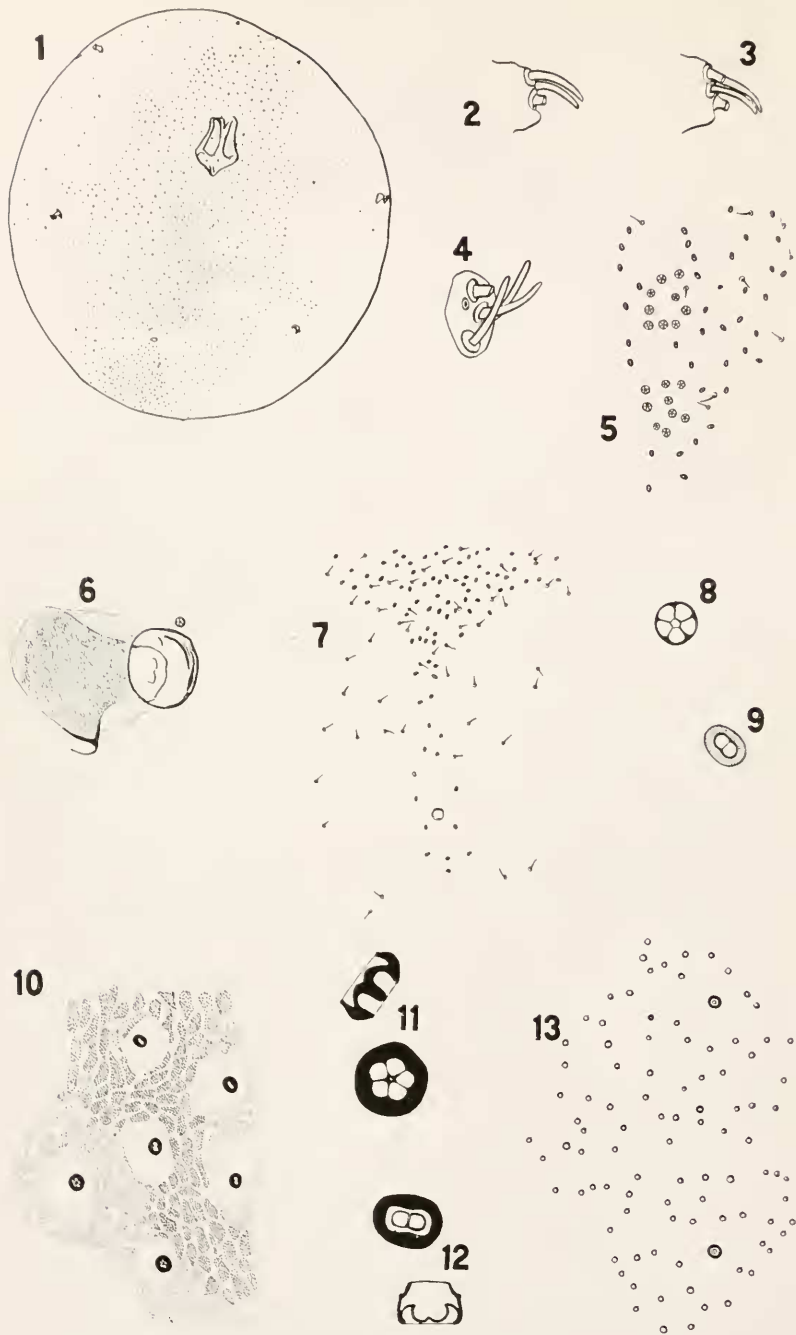
*Callococeus acaciae* (Maskell), second stage female and larvae.

Figure 1, dimorphic larva, outline, dorsal and ventral,  $\times 165$ ; 2, same, antenna,  $\times 530$ ; 3, normal larva, outline, dorsal and ventral,  $\times 165$ ; 4, same, apex of abdomen, dorsal and ventral,  $\times 530$ ; 5, assumed second stage female, antenna,  $\times 530$ ; 6, same, outline, dorsal and ventral,  $\times 120$ ; 7, same, quinquelocular disk pore adjacent to spiracle,  $\times 1,500$ ; 8, same, spiracle to margin region,  $\times 530$ ; 9, same, tubular duct,  $\times 1,500$ ; 10, same, apex of abdomen, dorsal and ventral,  $\times 230$ .



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PLATE 5

*Callococcus acaciae* (Maskell), adult female, and  
*Callococcus leptospermi* (Maskell), adult female.

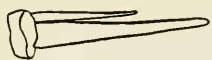
Figure 1. *acaciae*, outline of body, optical section,  $\times 18$ ; 2, 3, and 4, same, antennae,  $\times 820$ ; 5, same, portion of margin of dorsal band,  $\times 230$ ; 6, same, spiracle,  $\times 230$ ; 7, same, posterior apex of dorsal pore band, showing anal ring and adjacent pores and setae,  $\times 120$ ; 8, same, quinquelocular disk pore,  $\times 1,500$ ; 9, same, 8-shaped pore,  $\times 1,500$ ; 10, *leptospermi*, detail of portion of dorsal pore band,  $\times 350$ ; 11, same, larger quinquelocular disk pore, two views,  $\times 1,500$ ; 12, same, 8-shaped pore, two views,  $\times 1,500$ ; 13, same, area from middle section of dorsal pore band,  $\times 350$ .

PLATE 6

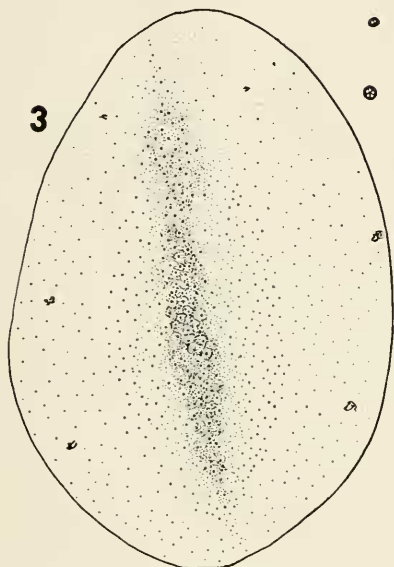
*Callococcus leptospermi* (Maskell), adult female.

Figure 1, apical seta, from posterior ventral apex of body,  $\times 530$ ; 2, area from anterior median section of dorsal pore band,  $\times 350$ ; 3, outline of body, somewhat schematic,  $\times 7.5$ ; 4, minute simple pores from middle of dorsal pore band,  $\times 530$ ; 5, same,  $\times 1,500$ ; 6, anterior end of dorsal pore band,  $\times 230$ ; 7, antenna,  $\times 350$ ; 8, area from posterior section of dorsal pore band,  $\times 350$ .





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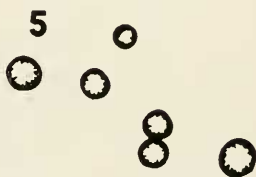
3



2



4



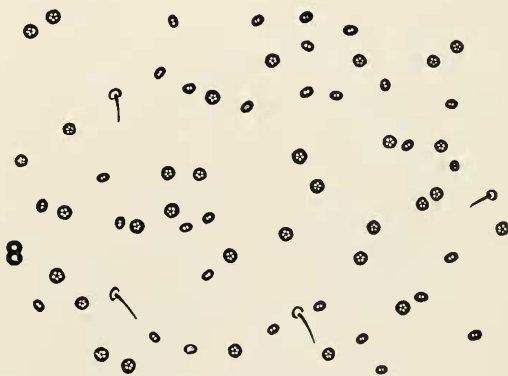
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7



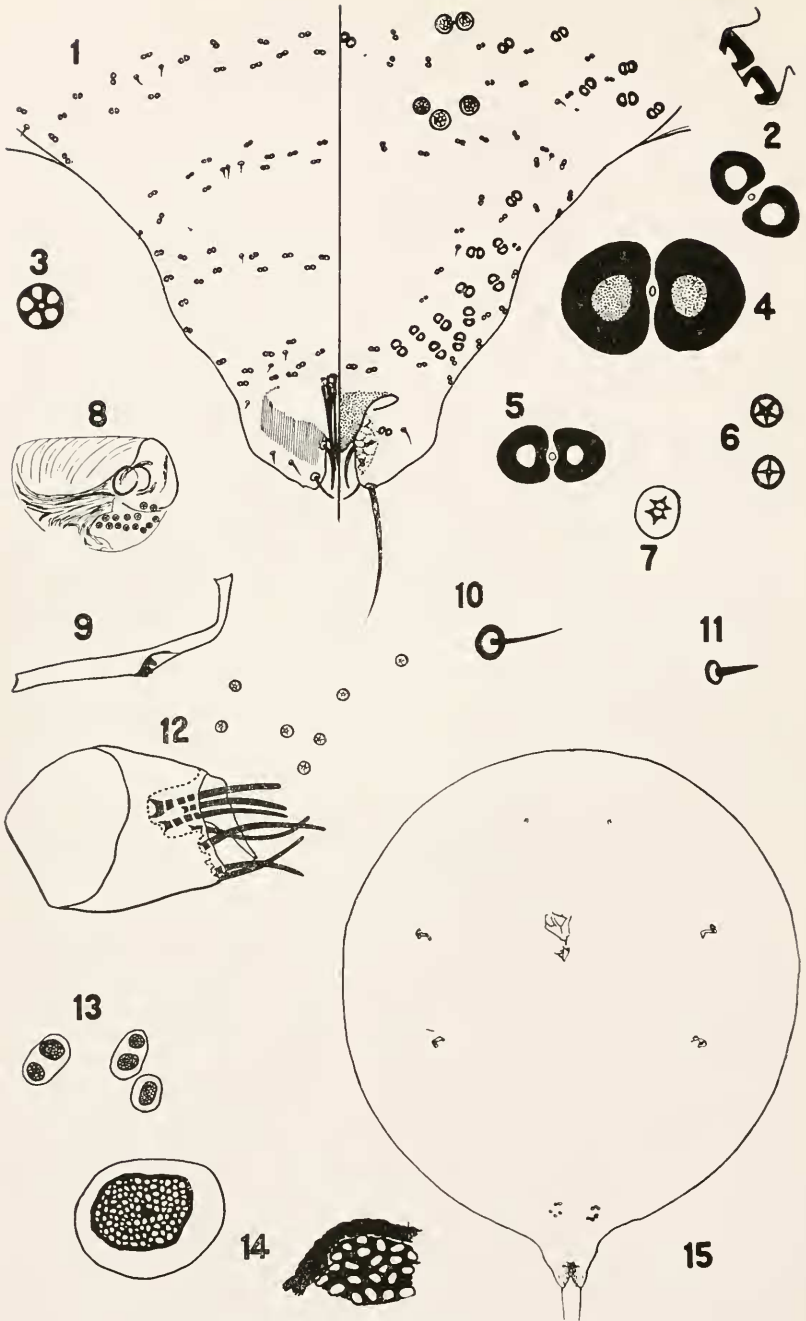
6



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PLATE 7

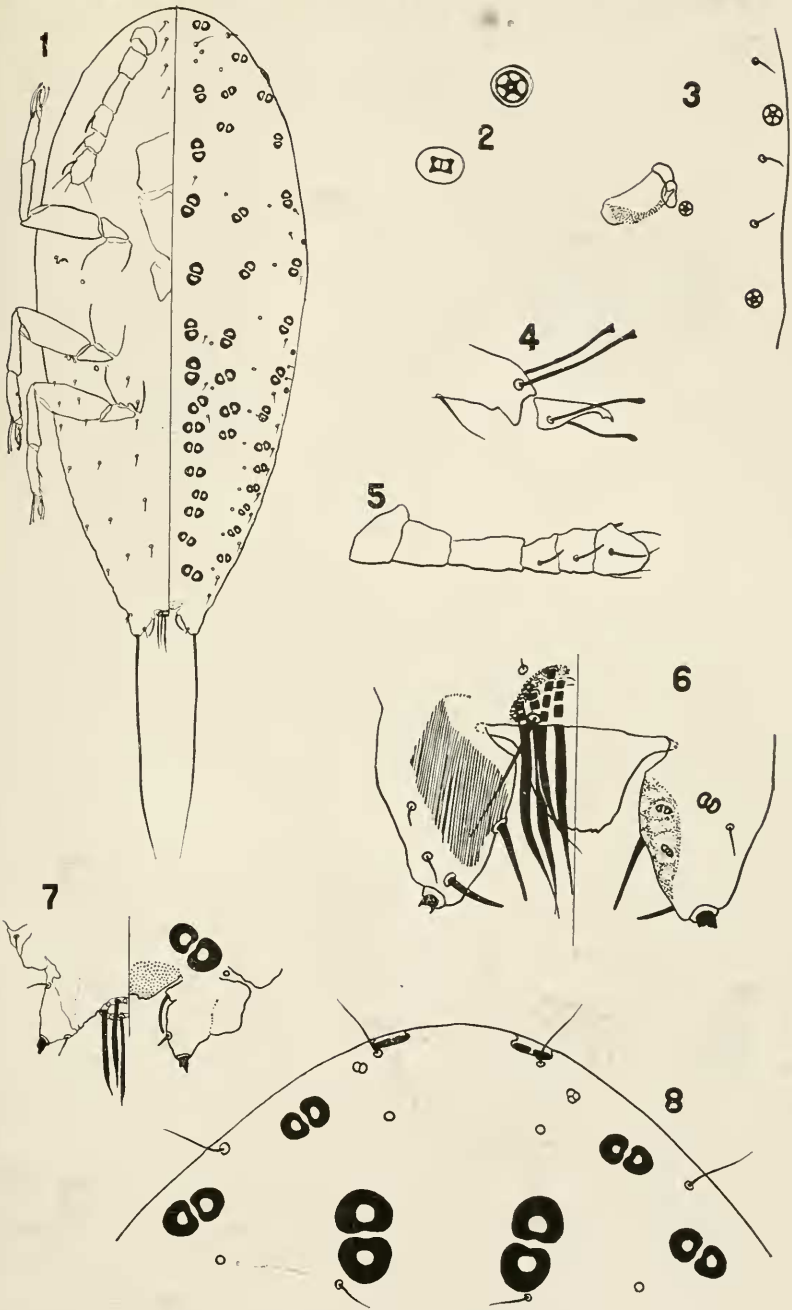
*Cerococcus bryoides* (Maskell), adult female.

Figure 1. apex of abdomen, dorsal and ventral,  $\times 165$ ; 2, dorsal smaller 8-shaped pore, two views,  $\times 1,500$ ; 3, spiracular quinquelocular disk pore,  $\times 1,500$ ; 4, largest sized 8-shaped pore,  $\times 1,500$ ; 5, normal ventral 8-shaped pore,  $\times 1,500$ ; 6, ventral quinquelocular disk pores not associated with spiracles,  $\times 1,500$ ; 7, ventral modified 8-shaped pore,  $\times 1,500$ ; 8, anterior spiracle,  $\times 350$ ; 9, tubular duct,  $\times 1,500$ ; 10, seta from the posterior ventral area of the abdomen,  $\times 1,500$ ; 11, seta from the anterior ventral area of the body,  $\times 1,500$ ; 12, antenna,  $\times 650$ ; 13, one of the double clusters of eribriform plates,  $\times 230$ ; 14, single cribriform plate,  $\times 820$ , with detail of portion of same,  $\times 1,500$ ; 15, outline of body, optical section,  $\times 18$ .

PLATE 8

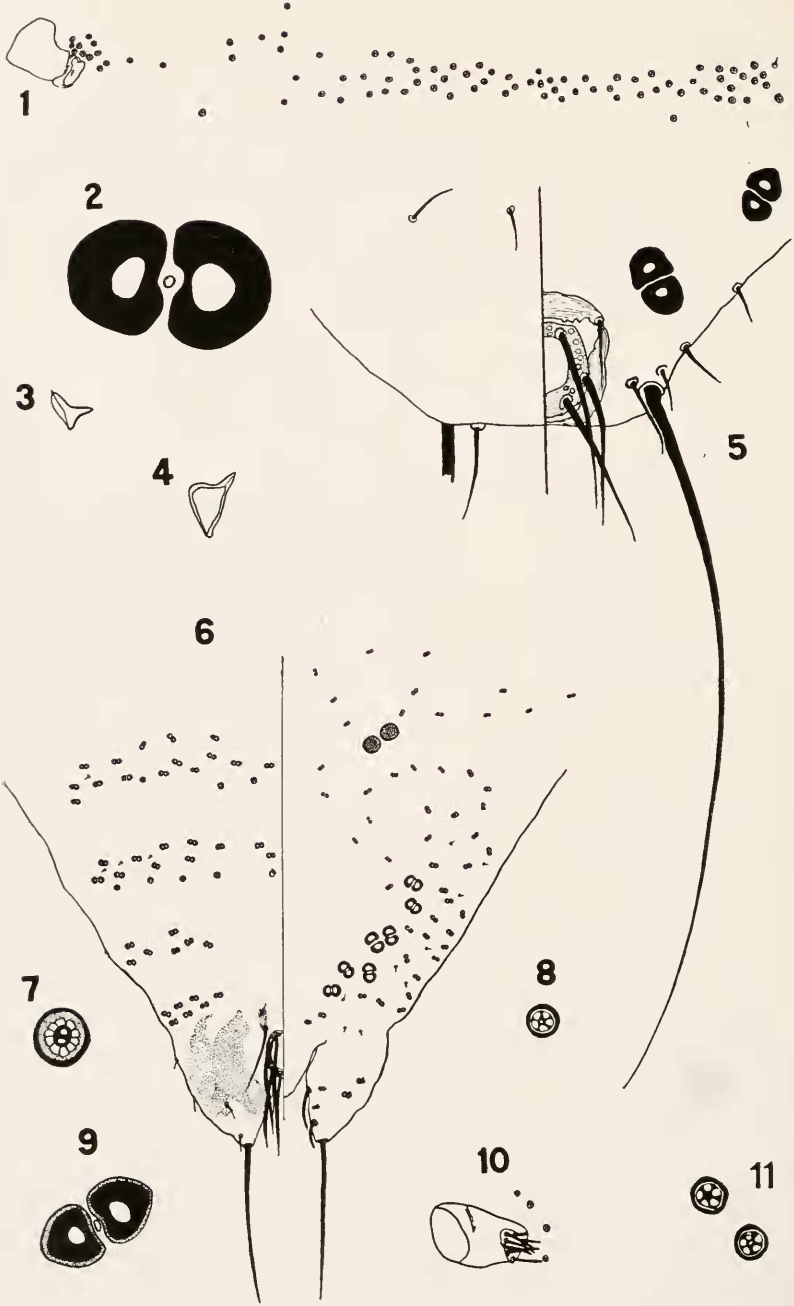
*Cerococcus bryoides* (Maskell), larva and adult female.

Figure 1, larva, dorsal and ventral,  $\times 230$ ; 2, larva, derm pore types,  $\times 500$ ; 3, larva, posterior spiracle to margin area,  $\times 820$ ; 4, larva, apex of tarsus,  $\times 820$ ; 5, larva, antenna,  $\times 430$ ; 6, adult female, apex of abdomen, dorsal and ventral,  $\times 530$ ; 7, larva, apex of abdomen, dorsal and ventral,  $\times 820$ ; 8, larva, anterior apex of body, dorsal,  $\times 820$ .



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PLATE 9

*Cerococcus frogatti*, new species, adult female and larva.

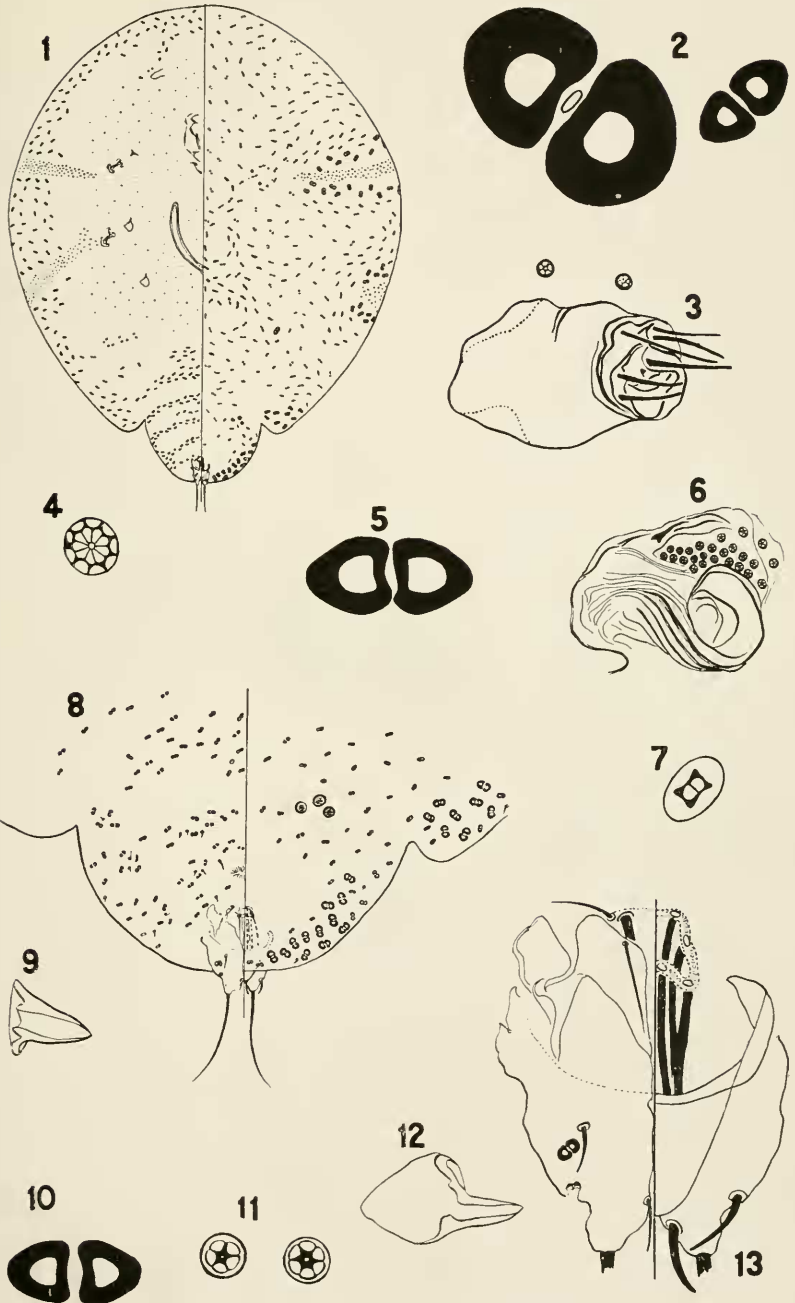
Figure 1. adult female, anterior spiracle to margin band of quinquelocular disk pores,  $\times 120$ ; 2, same, largest sized 8-shaped pore,  $\times 1,280$ ; 3, same, anterior leg,  $\times 230$ ; 4, same, posterior leg,  $\times 230$ ; 5, larva, apex of abdomen, dorsal and ventral,  $\times 165$ ; 6, adult female, apex of abdomen, dorsal and ventral,  $\times 165$ ; 7, same, ventral posterior abdominal multilocular disk pore,  $\times 1,280$ ; 8, same, antennal quinquelocular disk pore,  $\times 1,280$ ; 9, same, smaller sized, 8-shaped pore,  $\times 1,280$ ; 10, same, antenna,  $\times 230$ ; 11, same, spiracular quinquelocular disk pore,  $\times 1,280$ .

PLATE 10

*Cerococcus paradoxus* (Maskell), adult female.

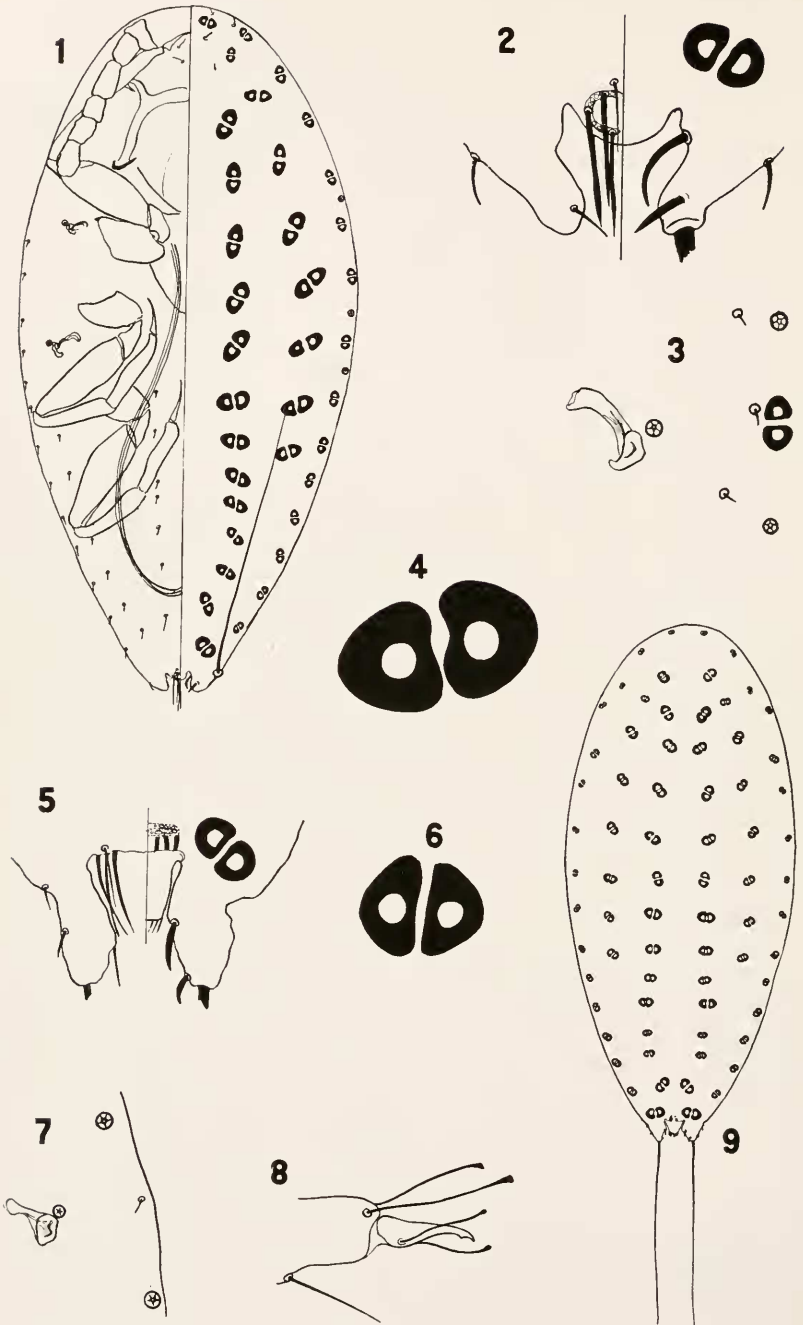
Figure 1, outline, dorsal and ventral,  $\times 27$ ; 2, dorsal 8-shaped pores, showing size variation,  $\times 1,500$ ; 3, antenna,  $\times 530$ ; 4, ventral abdominal quinquelocular disk pore,  $\times 1,500$ ; 5, ventral 8-shaped pore,  $\times 1,500$ ; 6, anterior spiracle,  $\times 820$ ; 7, modified ventral 8-shaped pore,  $\times 1,500$ ; 8, posterior apex of body, dorsal and ventral,  $\times 90$ ; 9, anterior leg,  $\times 530$ ; 10, ventral 8-shaped pore,  $\times 1,500$ ; 11, spiracular quinquelocular disk pores,  $\times 1,500$ ; 12, posterior leg,  $\times 530$ ; 13, anal ring, cauda, apical lobes, dorsal and ventral,  $\times 350$ .





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PLATE 11

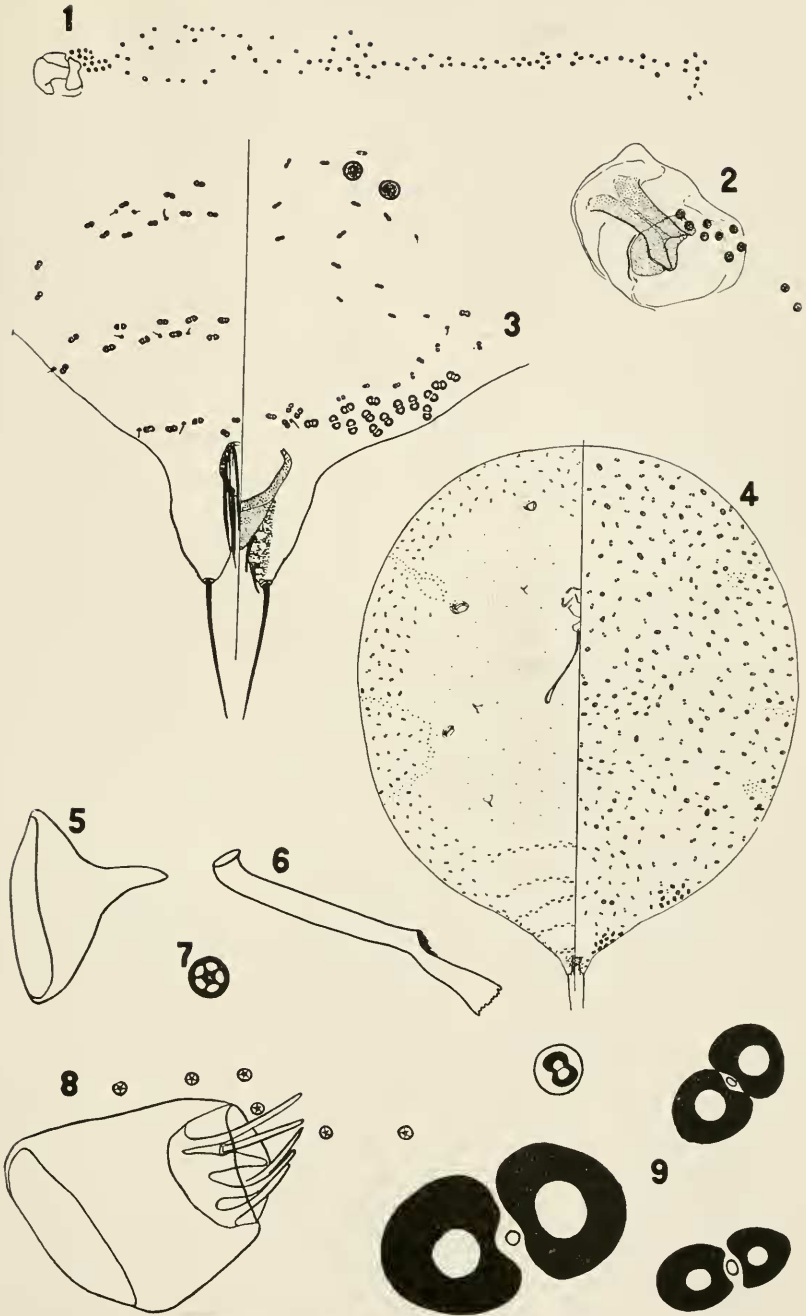
*Cerococcus paradoxus* (Maskell), larva, and  
*Cerococcus stellatus* (Maskell), larva.

Figure 1, *paradoxus*, outline dorsal and ventral,  $\times 230$ ; 2, same, posterior apex of body, dorsal and ventral,  $\times 820$ ; 3, same, posterior spiracle to margin region,  $\times 820$ ; 4, *stellatus*, largest 8-shaped pore,  $\times 1,500$ ; 5, same, posterior apex of body,  $\times 650$ ; 6, same, smaller 8-shaped pore,  $\times 1,500$ ; 7, same, spiracle to margin region,  $\times 820$ ; 8, same, apex of tarsus,  $\times 820$ ; 9, same, outline, dorsal,  $\times 180$ .

PLATE 12

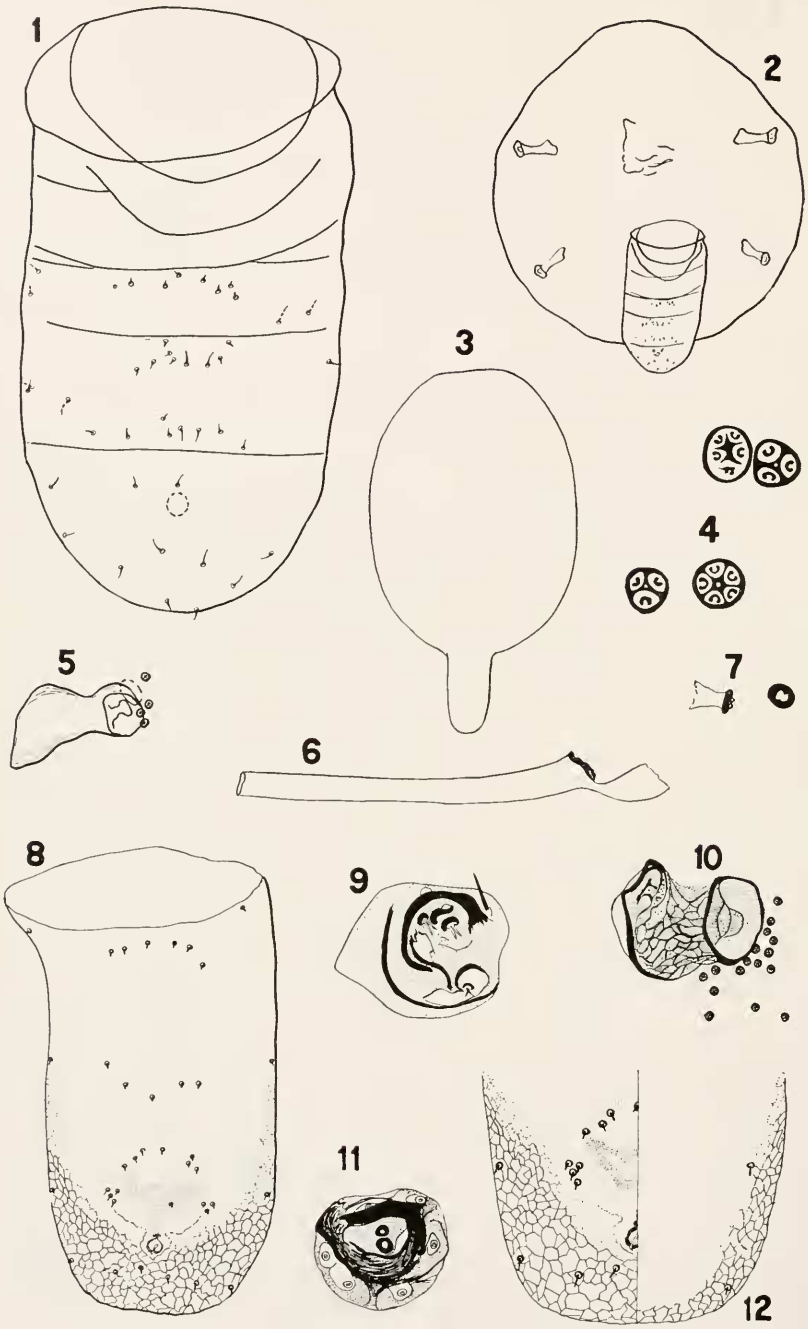
*Cerococcus stellatus* (Maskell), adult female.

Figure 1, spiracle to margin pore band,  $\times 120$ ; 2, spiracle,  $\times 350$ ; 3, posterior apex of body, dorsal and ventral,  $\times 165$ ; 4, outline, dorsal and ventral,  $\times 27$ ; 5, anterior leg,  $\times 650$ ; 6, tubular duct,  $\times 1,500$ ; 7, spiracular quinquelocular disk pore,  $\times 1,500$ ; 8, antenna with adjacent pores,  $\times 650$ ; 9, variations in 8-shaped pores,  $\times 1,500$ .



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PLATE 13

*Frenchia semioculta* Maskell, adult female.

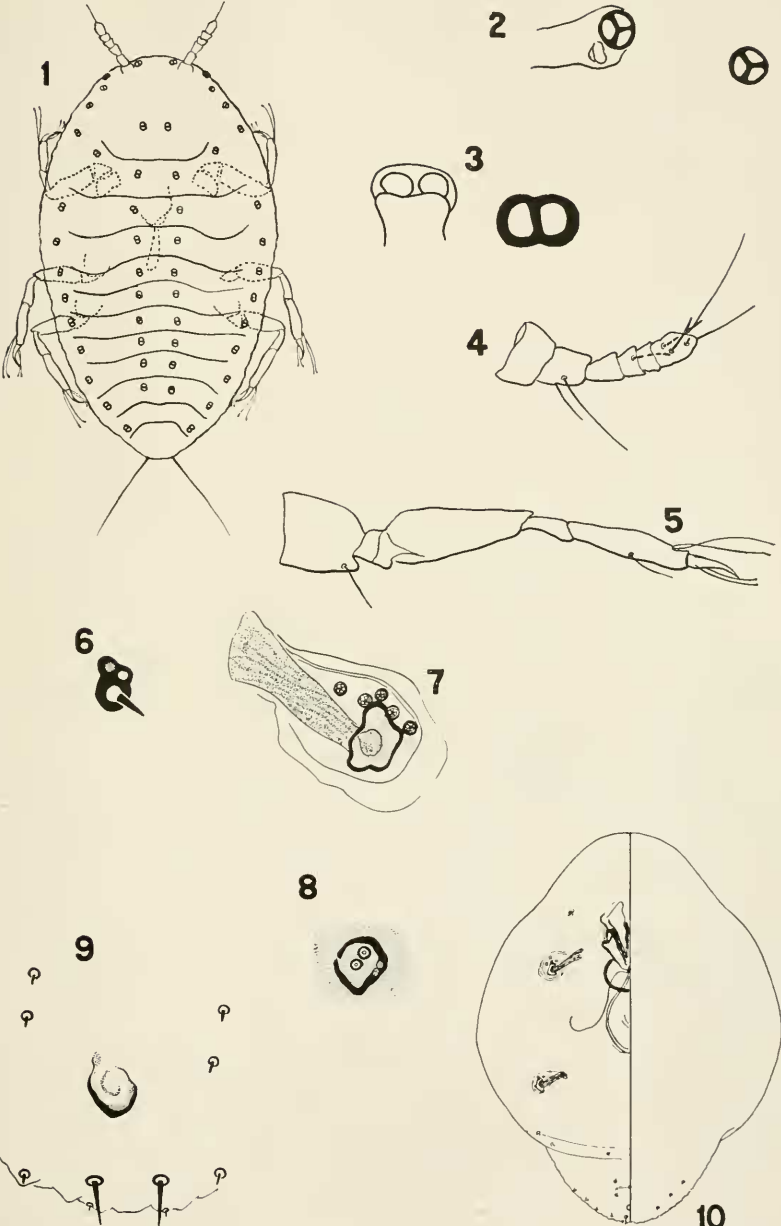
Figure 1. produced apex of abdomen, or "tail," from Maskell slide,  $\times 230$ ; 2, outline of body, optical section, from Maskell slide,  $\times 60$ ; 3, outline of body, from cotype specimen,  $\times 27$ ; 4, types of derm disk pores,  $\times 1,500$ ; 5, spiracle, from Maskell slide,  $\times 230$ ; 6, tubular duct,  $\times 1,500$ ; 7, modified 8-shaped pore,  $\times 1,500$ ; 8, apex of abdomen or "tail," from cotype specimen,  $\times 180$ ; 9, antenna, from cotype specimen,  $\times 820$ ; 10, spiracle, from cotype specimen,  $\times 230$ ; 11, another antenna,  $\times 820$ ; 12, apex of "tail," dorsal and ventral,  $\times 230$ .

PLATE 14

*Frenchia semioculta* Maskell, larva and intermediate stage.

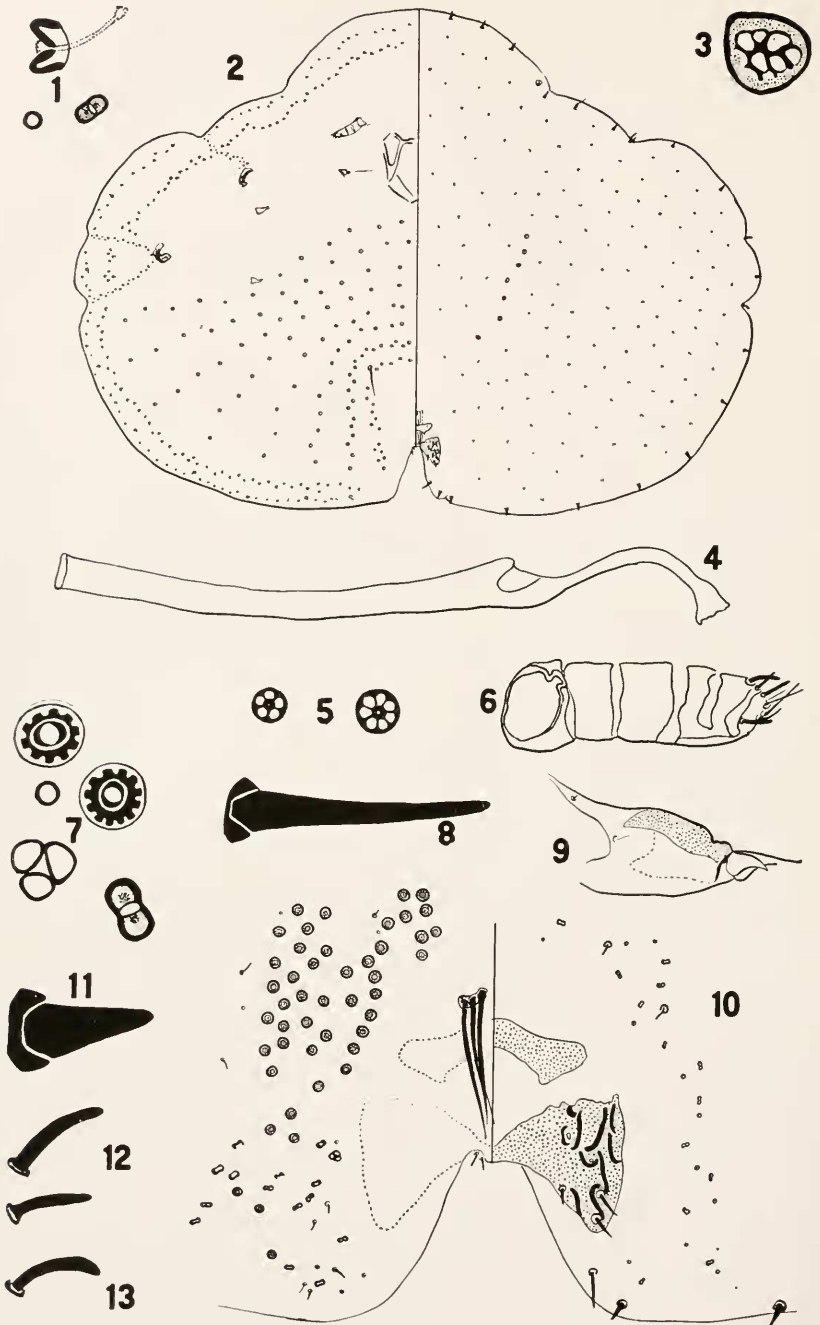
Figure 1, larva, outline, dorsal,  $\times 165$ ; 2, larva, spiracle and adjacent pore,  $\times 1,280$ ; 3, larva, 8-shaped pore, two views,  $\times 1,280$ ; 4, larva, antenna,  $\times 430$ ; 5, larva, leg,  $\times 430$ ; 6, intermediate female, pore and seta near posterior spiracle,  $\times 1,500$ ; 7, same, anterior spiracle,  $\times 530$ ; 8, same, antenna,  $\times 820$ ; 9, same, posterior apex of body,  $\times 530$ ; 10, same, outline, dorsal and ventral,  $\times 90$ .





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PLATE 15

*Lecaniodiaspis acaciae* (Maskell), adult female.

Figure 1, types of dorsal derm pores,  $\times 1,500$ ; 2, outline of old adult female, dorsal and ventral,  $\times 60$ ; 3, single cribriform plate,  $\times 1,500$ ; 4, tubular duct,  $\times 1,500$ ; 5, spiracular multilocular disk pores,  $\times 1,500$ ; 6, antenna,  $\times 350$ ; 7, types of posterior ventral abdominal derm pores,  $\times 1,500$ ; 8, apical seta,  $\times 1,500$ ; 9, middle leg,  $\times 350$ ; 10, posterior apex of body, dorsal and ventral,  $\times 230$ ; 11, marginal seta,  $\times 1,500$ ; 12, anterior apiracular spines,  $\times 350$ ; 13, cephalad posterior spiracular spine,  $\times 350$ .